SOIL SURVEY OF

Nuckolls County, Nebraska

United States Department of Agriculture
Soil Conservation Service
in cooperation with
University of Nebraska
Conservation and Survey Division

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1968-73. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1974. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska Conservation and Survey Division.It is part of the technical assistance furnished to the Little Blue Natural Resources District and the Lower Republican Natural Resources District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Nuckolls County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units," at the back of this survey, can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the windbreak suitability group and range site to which the soil has been assigned.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the descriptions of the capability units, the range sites, and the windbreak suitability groups.

Foresters and others can refer to the section "Windbreaks," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about soil formation and classification in the section "Formation and Classification of Soils."

Newcomers in Nuckolls County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Environmental Factors Affecting Soil Use."

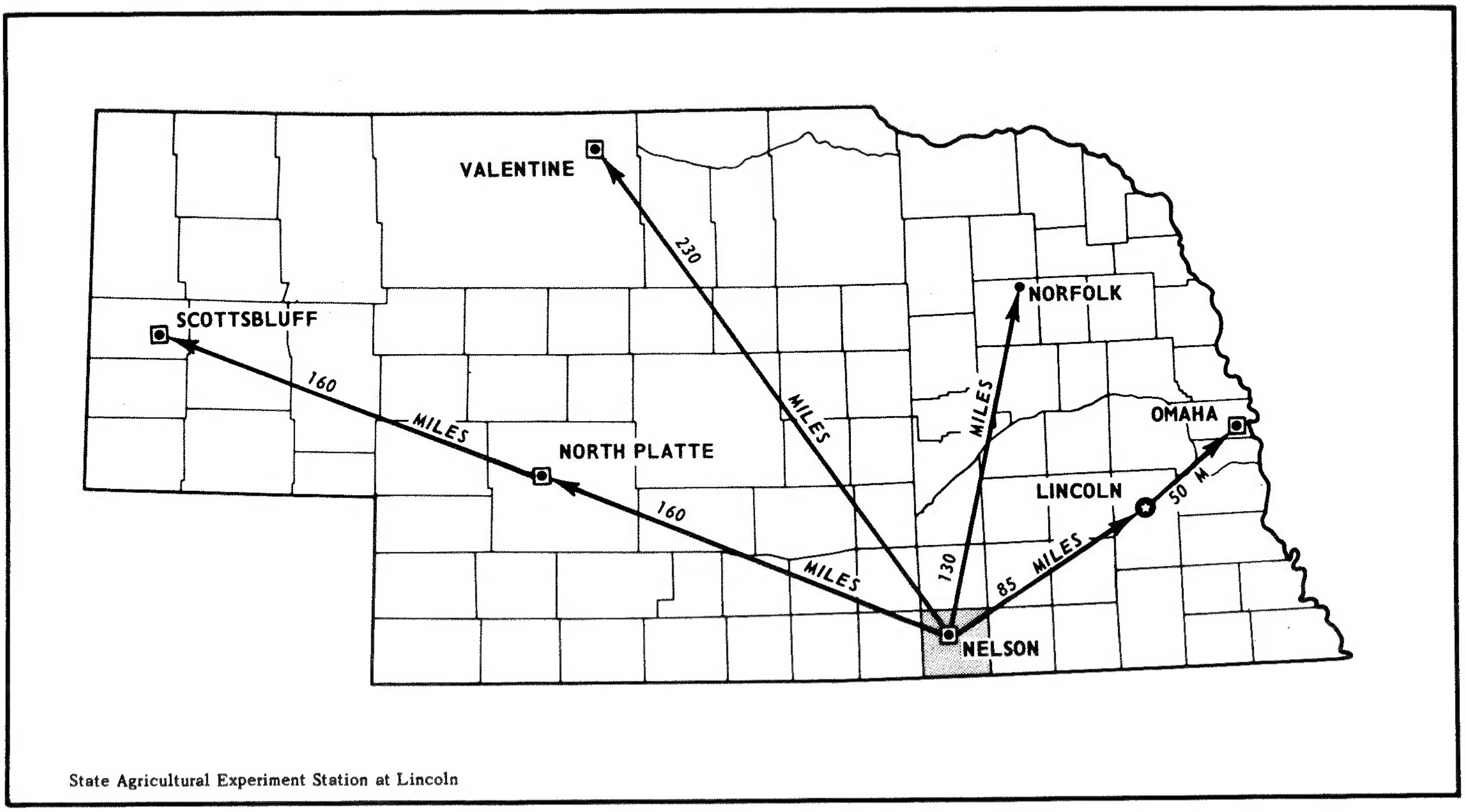
Cover: Contour irrigation, terraces, and grassed waterways on Geary-Hastings association.

Contents

Issued May 1978

Index to Mapping Units

Summary of Tables



Location of Nuckolls County in Nebraska.

SOIL SURVEY OF NUCKOLLS COUNTY, NEBRASKA

BY ROBERT S. POLLOCK AND LYLE L. DAVIS,
SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH
UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

NUCKOLLS COUNTY is in the south-central part of Nebraska, adjoining Kansas (see facing page). The county is approximately 24 miles square and covers an area of 370,560 acres. Nelson is the county seat. Superior is the largest town.

Nuckolls County was organized in 1871. By 1880 the population had increased to 4,200. It increased to a peak of about 13,200 in 1920, after which it declined. In 1970 it was 7,404. The population is concentrated largely in the towns and villages. The economy is based on farming or farm-related industry.

In 1969 the U.S. Census reported 242,273 acres of cultivated land in Nuckolls County, of which 28,541 acres, or about 11 percent, was irrigated. Most farms are the diversified livestock and grain type. Fattening cattle and hogs is the main livestock industry. The major crops are grain sorghum, corn, wheat, and alfalfa. Wheat is a cash crop. The other crops are fed to livestock, and the excess is sold for cash.

About 95 percent of the acreage of the county is in farms, and the average farm is 452 acres. About 25 percent of the farms are operated by tenants.

Water for irrigation is available from deep wells in the northeastern and eastern parts of the county. In the Republican River Valley, irrigation water is available from a reservoir upstream in Harlan County; it is delivered through the Bostwick Irrigation District Canal.

Nuckolls County is in the Loess Plains part of the Great Plains physiographic province. The Republican River enters the county from the west, 4 miles north of the Kansas boundary, and flows in an east-southeast direction across the southern part. The Little Blue River enters the county from the north and flows southeasterly.

The soils in Nuckolls County formed mainly in silty material of the loess uplands and in loamy, silty, and sandy alluvium of the stream valleys. The uplands consist of broad divides separated by many intermittent drainageways.

A network of hard-surface roads and railway branch lines serve all the larger towns. Superior and Nelson have airstrips that serve local users.

The first soil survey of Nuckolls County was published in 1925 *(5)*.[1] The present survey updates the earlier survey and provides additional information and larger, more detailed maps.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Nuckolls County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and nature of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Crete and Hastings, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Hastings silt loam, 1 to 3 percent slopes, is one of four phases within the Hastings series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the

[1] Italic numbers in parentheses refer to Literature Cited, p. 78.

boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit, the undifferentiated soil group, is shown on the soil map of Nuckolls County.

An undifferentiated soil group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils joined by "and." Geary and Jansen silt loams, 3 to 6 percent slopes, is an undifferentiated soil group in Nuckolls County.

In most areas surveyed there are places where the soil material is so rocky, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Sandy alluvial land is a land type in this county.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing medium for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this failure to slow permeability or a high water table. They see that streets, road pavements, and foundations for houses crack on a given kind of soil, and they relate this failure to a high shrink-swell potential. Thus, they use observation and knowledge of soil properties, together with available research data, to predict the limitations or suitability of a soil for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their study and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in an association can occur in other associations, but in different patterns.

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to locate large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide for broad planning on a watershed, a wooded tract, or a wildlife area or for broad planning of recreational facilities, community developments and such engineering works as transportation corridors. It is not a suitable map for detailed planning for management of a farm or field or for selecting the exact location of a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The eight soil associations in this survey area are described on the pages that follow.

1. Hastings association

Deep, nearly level to gently sloping, well drained silty soils on loess uplands

This association occupies loess uplands at the highest elevation of the landscape. It is mostly on the tops and sides of ridges. Small, shallowly entrenched intermittent drainageways are common.

This association makes up about 61,600 acres, or 17 percent of the county. It is about 89 percent Hastings soils and 11 percent soils of minor extent.

Hastings soils are on the highest position on the upland landscape. They are nearly level to gently sloping and well drained. They have a thick surface layer of silt loam. The subsoil is silty clay loam, and the underlying material is calcareous silt loam.

Of minor extent in this association are Butler, Crete, Geary, Hall, and Holder soils. The somewhat poorly drained Butler soils are in shallow upland depressions. The nearly level Crete and Hall soils are at the same elevation as Hastings soils. Geary soils are at the lowest elevations on the steeper parts of intermittent drainageways. Holder soils border intermittent drainageways and are below areas of Hastings soils.

Nearly all of this association is cultivated. The soils are well suited to irrigation, but only 20 percent of the area has sufficient water available from deep wells. Farming is mainly a cash grain-livestock type. Fattening beef cattle and hogs is the most important livestock

enterprise. Wheat, grain sorghum, and alfalfa are the main crops.

The main concerns of management are conserving moisture, controlling runoff, and maintaining the level of fertility and the supply of organic matter.

Farms on this association range from 240 to 640 acres in size. Gravel or improved dirt roads are on most section lines. Farm produce is marketed mainly within the county. Some livestock is marketed locally, but most of it is shipped to terminal markets, such as Omaha.

2. *Geary-Hastings association*

Deep, very gently sloping to steep, well drained silty soils on divides and side slopes of loess uplands

The landscape of this association is one of smooth divides, intermittent drainageways, and many creeks and streams. The soils formed in loess of the Peoria and Loveland Formations.

This association (fig. 1) makes up about 160,000 acres, or 43 percent of the county. It is about 38 percent Geary soils, 36 percent Hastings soils, and 26 percent soils of minor extent and land types.

Geary soils are in a lower position on the landscape than Hastings soils. They are gently sloping to steep and well drained. They have a thick surface layer of silt loam. The subsoil is silty clay loam, and the underlying material is reddish silt loam.

Hastings soils are on the higher positions of the upland divides. They are very gently sloping to gently sloping and well drained. They have a thick surface layer of silt loam. The subsoil is silty clay loam, and the underlying material is calcareous, brownish silt loam.

Less extensive soils in this association are Holder, Hord, Hobbs, and Uly soils. Holder soils are on side slopes at a lower elevation than Hastings soils and a higher elevation than Geary soils. Hord soils are on the bottoms of large drainageways, generally above the flood plain. Hobbs soils are on the narrow bottoms of drainageways where flooding is occasional and on the bottoms of large drainageways where there are deep, meandering channels and where flooding is frequent. Uly soils are on hillsides and side slopes at higher elevations than Geary soils.

The main concerns of management are controlling runoff to reduce erosion and conserving moisture. Proper range use and planned grazing are needed on native grasslands.

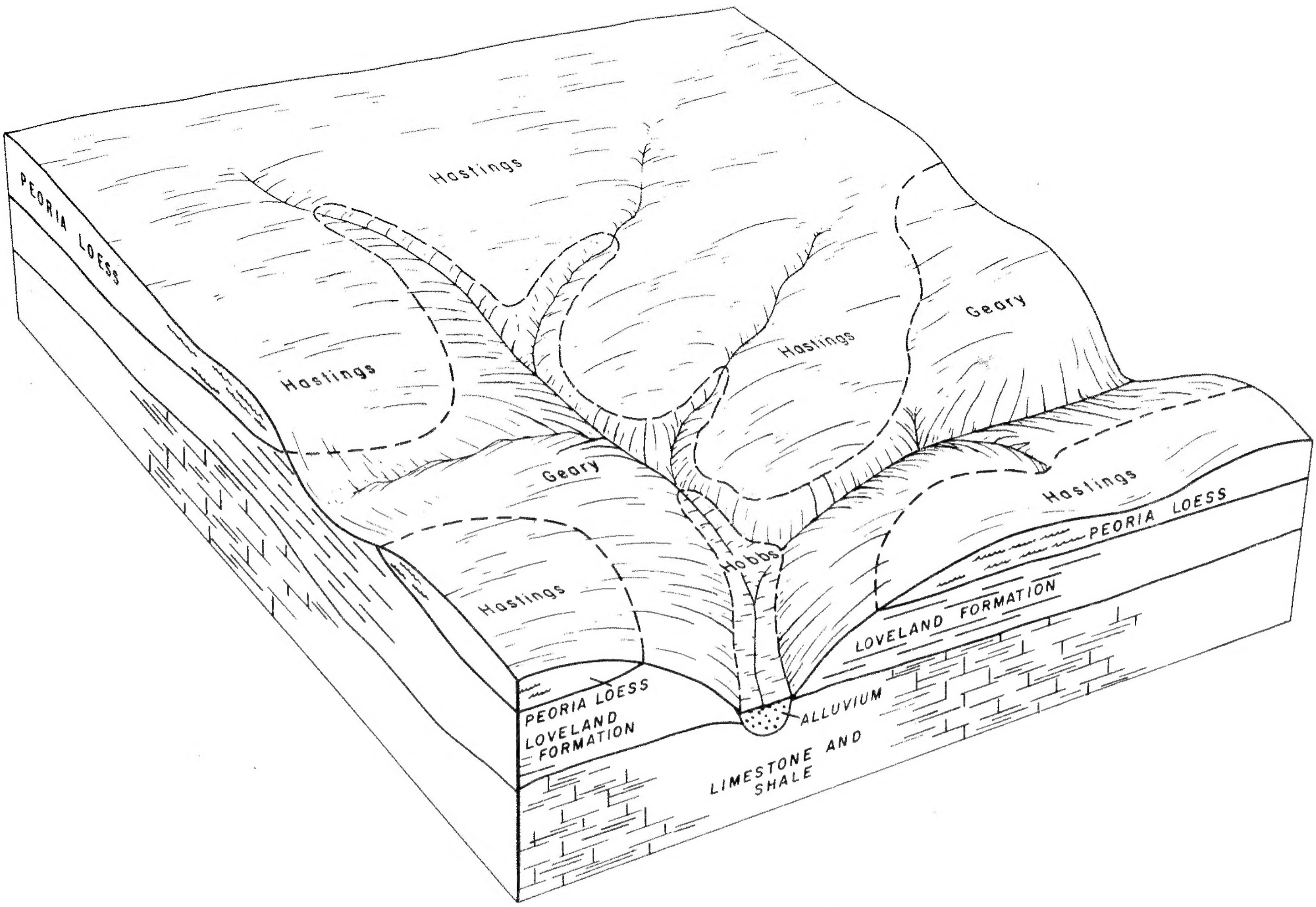


Figure 1.—**Pattern of soils and parent material in Geary-Hastings association.**

Farms are diversified. Feeding beef cattle and hogs in drylots is the most important livestock enterprise. Soils on the divides, which make up little more than half of the association, are used mainly for dryland cultivated crops, mainly wheat, grain sorghum, and alfalfa. The steep soils that border drainageways are used for grazing cattle. Sufficient water for irrigation is not available throughout most of this association.

Farms on this association range mainly from 320 to 800 acres in size, but some are as large as 1,600 acres. Gravel or improved dirt roads are on most section lines. Some paved highways cross the association. Produce, except livestock, is marketed mainly within the county. Some livestock is marketed locally, but most of it is shipped to terminal markets, such as Omaha.

3. Geary-Holder association

Deep, very gently sloping to steep, well drained silty soils on divides and side slopes of loess uplands

This association occupies ridgetops, side slopes, and drainageways in the loess uplands (fig. 2). The ridgetops are nearly level to gently sloping, and the side slopes between the ridgetops and drainageways are strongly sloping to steep. Some of the intermittent drainageways are spring-fed tributaries of the Republican River and the Little Blue River.

This association makes up about 6 percent of the county. It is about 43 percent Geary soils, 39 percent Holder soils, and 18 percent soils of minor extent and land types.

Geary soils are in a lower position on the upland landscape than Holder soils. They are gently sloping to steep and well drained. They have a thick surface layer of silt loam. The subsoil is silty clay loam, and the underlying material is reddish silt loam.

Holder soils are on the higher positions of the uplands. They are very gently sloping to strongly sloping and well drained. They have a thick surface layer of silt loam. The subsoil is light silty clay loam, and the underlying material is brownish silt loam.

Less extensive soils in this association are Hastings, Uly, Kipson, Hobbs, and Hord soils. The nearly level Hastings soils are on ridgetops above areas of Holder soils. The steep Uly soils are on side slopes below areas of Holder soils and above areas of Geary soils. The steep Kipson soils are on side slopes below areas of Geary soils. Hord soils and Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes, are on high bottom land along the larger intermittent drainageways. Hobbs silt loam, channeled, 0 to 3 percent slopes, is on the bottoms of the larger intermittent drainageways where there are deep, meandering channels and where flooding is more frequent.

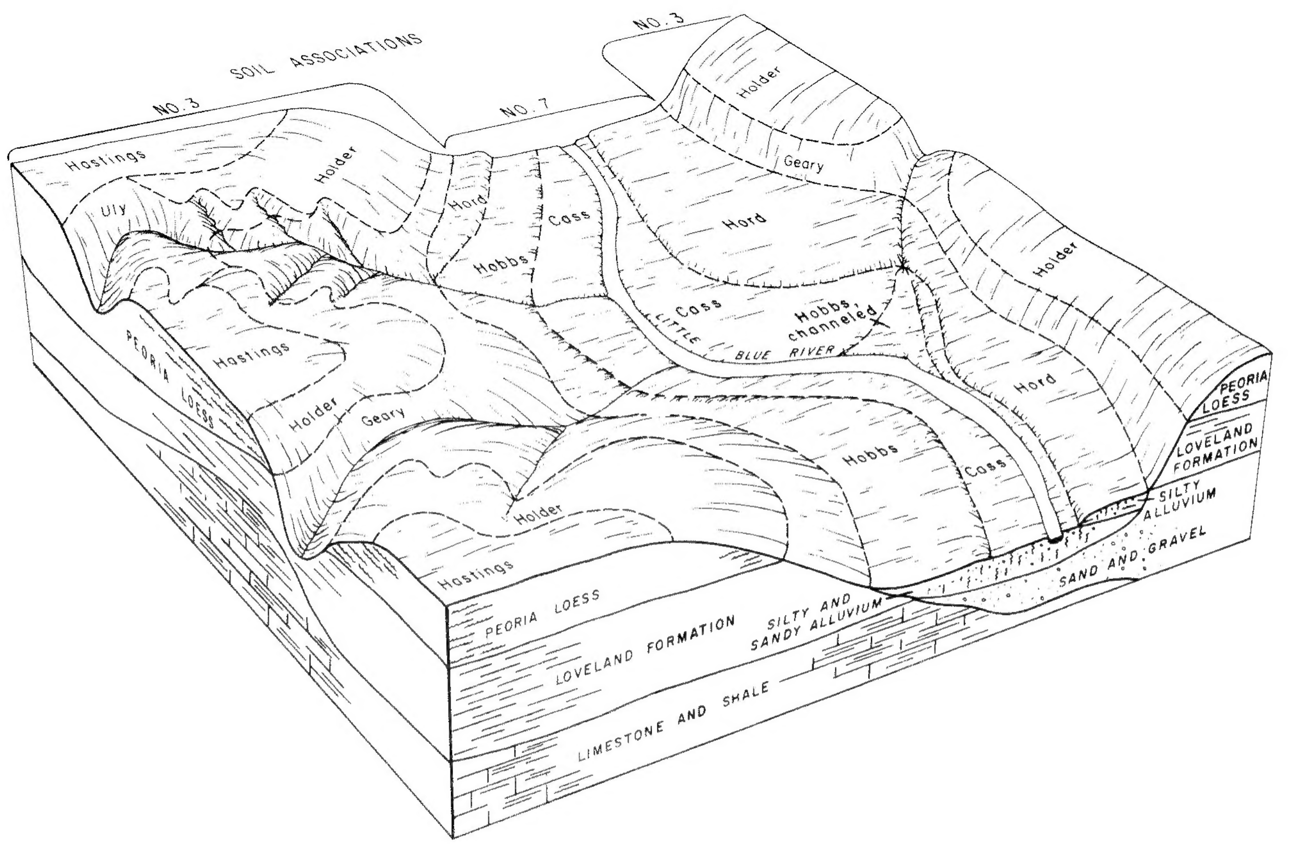


Figure 2.—Pattern of soils and parent material in Geary-Holder association and Hood-Cass-Hobbs association (association 7).

Control of runoff to reduce erosion and conserve moisture is needed on rangeland. Water erosion and drought are the main hazards in cultivated areas.

Farms are diversified. More than 70 percent of the association is strongly sloping to steep and is used mainly as range. Cattle feeding in drylot is an important livestock enterprise. Soils on the divides are used mainly for dryland cultivated crops. Grain sorghum, wheat, and alfalfa are the main crops. Sufficient water for irrigation is not available throughout most of the association.

The farms on this association commonly extend into adjacent associations. The size of the farms ranges from 320 to 1,280 acres. Gravel or improved dirt roads are on about half of the section lines. Farm produce is marketed mainly within the county. Most of the livestock is sent by truck to terminal markets in Omaha or to markets in adjacent counties.

4. Crete-Hastings association

Deep, nearly level to gently sloping, moderately well drained and well drained silty soils on loess uplands

This association is on a broad, nearly level to gently sloping plain of the loess uplands. It includes a few shallow entrenched intermittent drainageways and also the South Fork of the Big Sandy Creek. It has many shallow depressions.

This association (fig. 3) makes up about 79,500 acres, or 21 percent of the county. It is about 76 percent Crete soils, 14 percent Hastings soils, and 10 percent soils of minor extent.

Crete soils are in broad upland areas. They are nearly level and moderately well drained. They have a thick surface layer of silt loam. The subsoil is silty clay, and the underlying material is calcareous silt loam.

Hastings soils are on the low ridges or side slopes along drainageways in the uplands. They are nearly level to gently sloping and well drained. They have a thick surface layer of silt loam. The subsoil is silty clay loam, and the underlying material is calcareous silt loam.

Less extensive in this association are Butler, Fillmore, Scott, and Holder soils and Marsh. The somewhat poorly drained to poorly drained Butler, Fillmore, and Scott soils are in shallow upland depressions. Holder soils border intermittent drainageways, below areas of Hastings soils. Marsh is in upland depressions that are ponded during most of the growing season.

Slow runoff, maintenance of soil tilth, and conservation of moisture are the main concerns of dryland man-

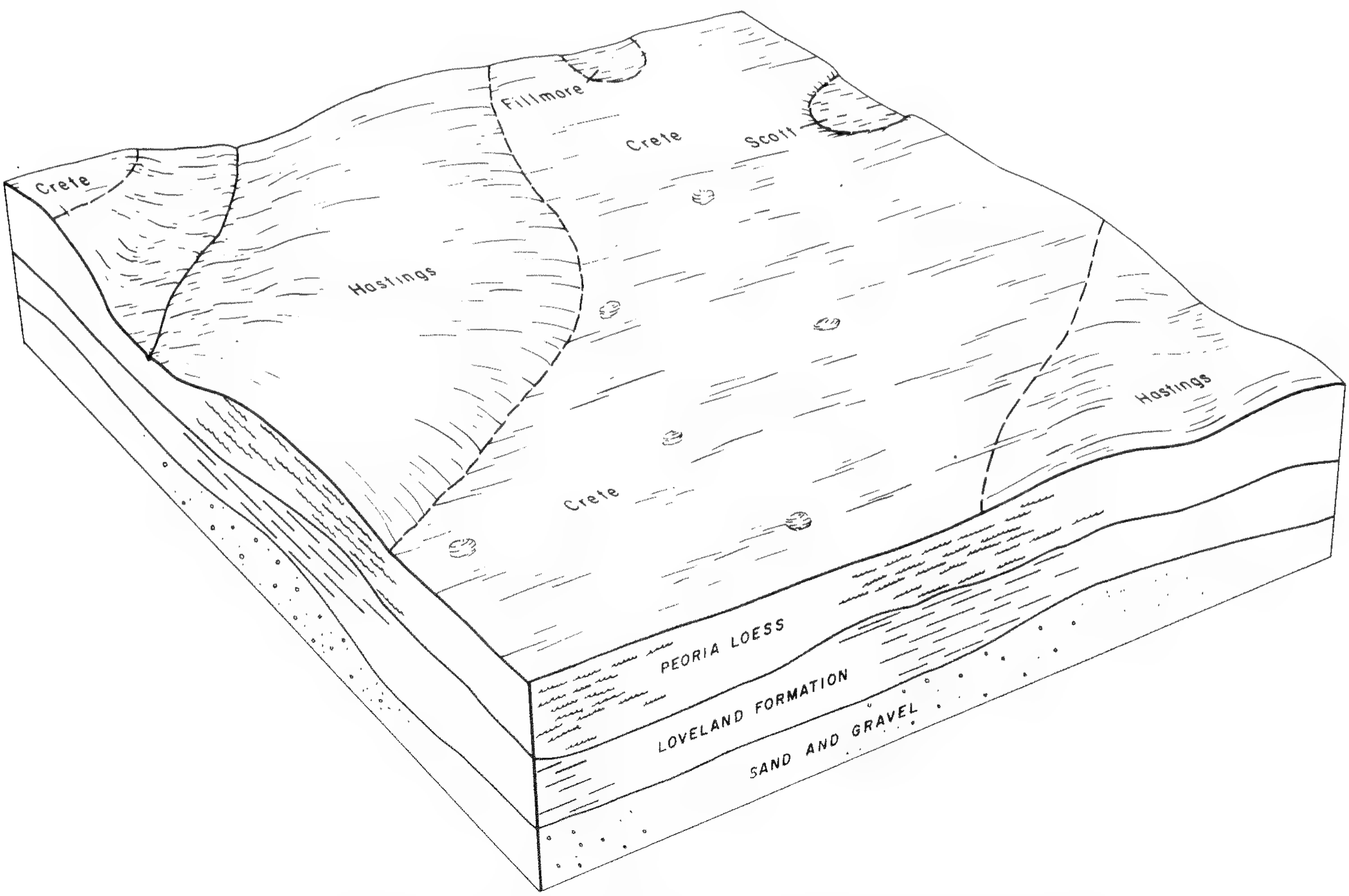


Figure 3.—Pattern of soils and parent material in Crete-Hastings association.

agement. Maintenance of fertility, control and re-use of irrigation tail water, and slow permeability are the important concerns on irrigated land. A limited acreage is in native grasses and is used for range.

Most farms are the cash grain-livestock type. Nearly all the acreage is cultivated, and about 35 percent is irrigated. Wheat, grain sorghum, and alfalfa are the main dryland crops. Corn and grain sorghum are the chief irrigated crops. The part of this association in the northeast corner of the county is the only area that has sufficient ground water for well irrigation. Beef cattle and hogs are the main livestock fattened in feedlots on this association.

The farms on this association range mainly from 160 to 480 acres in size, but some are as large as 960 acres. Gravel or improved dirt roads are on most section lines. Paved highways are common. Farm produce, except livestock, is marketed mainly within the county, but some is delivered to markets in adjacent counties. Some livestock is marketed locally, but most of it is shipped by truck to terminal markets, such as Omaha.

5. *Geary-Jansen-Meadin association*

Deep, gently sloping to steep, well drained silty soils and gently sloping to steep, well drained and excessively drained silty and loamy soils that are moderately deep and shallow over sand and gravel; on uplands

This association occupies dissected upland breaks bordering the Republican River Valley. It also occupies the valleys of a few creeks. The ridgetops are gently sloping to strongly sloping, and the side slopes along the drainageways are steep. The soils formed in loess over sand and gravel.

This association makes up about 11,400 acres, or 3 percent of the county. It is about 32 percent Geary soils, 38 percent Geary and Jansen soils, 6 percent Meadin soils, and 24 percent soils of minor extent.

Geary soils are on the higher part of the upland landscape. They are gently sloping to steep, deep, and well drained. They have a thick surface layer of silt loam. The subsoil is silty clay loam, and the underlying material is silt loam. Sand and gravel are below a depth of 4 feet in many places.

Jansen soils are below the Geary soils on the upland landscape. They are gently sloping to strongly sloping, moderately deep over mixed sand and gravel, and well drained. They have a thick surface layer of silt loam. The subsoil is clay loam, and the underlying material is mixed sand and gravel.

Meadin soils are at the lower elevations of the upland landscape. They are strongly sloping to steep, shallow over mixed sand and gravel, and excessively drained. They have a surface layer of loam and a transition layer of lighter colored loam. The underlying material is mixed sand and gravel.

Less extensive soils in this association are Hastings, Holder, and Hobbs soils. Hastings and Holder soils are on the ridgetops above areas of Geary soils. Hobbs soils are on the bottoms of drainageways where flooding is occasional.

Water erosion and drought are the main hazards. Proper range use and a planned grazing system, control of water erosion, and conservation of moisture are needed on rangeland.

Farms are mainly the general livestock type. Drylot feeding of beef cattle and hogs is the main livestock enterprise. Some farms are diversified and include cash grain grown on soils of adjacent associations. Most of the acreage is in native grasses. The gently sloping soils, which are commonly on ridgetops, are suitable for cultivating. Grain sorghum and wheat are the principal crops. The irregular topography and the limited supply of irrigation water restricts irrigation.

The farms on this association commonly extend into adjacent associations. The size of the farms ranges from 160 to 640 acres. Gravel or improved dirt roads are on most section lines. Farm produce, except livestock, is marketed mainly within the county. Some livestock is marketed locally, but most of it is shipped by truck to terminal markets, such as Omaha.

6. *Hord association*

Deep, nearly level to gently sloping, well drained silty soils on stream terraces

This association occupies stream terraces of the Little Blue River Valley, the Republican River Valley, and a few valleys of the larger tributaries. The soils are nearly level to gently sloping.

This association (fig. 4) makes up about 10,200 acres, or 3 percent of the county. It is about 79 percent Hord soils and 21 percent soils of minor extent.

Hord soils are on high bottom land and terraces. They are nearly level to gently sloping and are well drained. They have a thick surface layer of silt loam. The subsoil is silt loam that is about as dark as the surface layer, and the underlying material is light colored silt loam.

Less extensive soils in this association are Hall, Hobbs, and Cozad soils. Hall and Cozad soils are in positions similar to those of Hord soils. Hobbs soils are on the bottoms of large drainageways where there are deep, meandering channels and where flooding is frequent.

The main concerns of management are maintaining fertility and good tilth and conserving moisture. The control and re-use of irrigation tail water is important in irrigated areas.

Farms are diversified. Most are the cash grain-livestock type. Nearly all soils of this association in the Republican River Valley are irrigated from canals. In the rest of the county the soils are dryfarmed or are irrigated from wells. Corn and grain sorghum are the main irrigated crops. Grain sorghum, wheat, and alfalfa are the chief dryland crops. A limited acreage is used for pasture. Fattening cattle and hogs in feedlots is common.

Most farms range from 240 acres to 640 acres in size. Gravel roads are on most section lines. Some paved highways cross the area. Farm produce, except livestock, is marketed mainly within the county. Some livestock is marketed locally, but most of it is shipped by truck to terminal markets, mainly Omaha.

7. *Hord-Cass-Hobbs association*

Deep, nearly level, well drained and moderately well

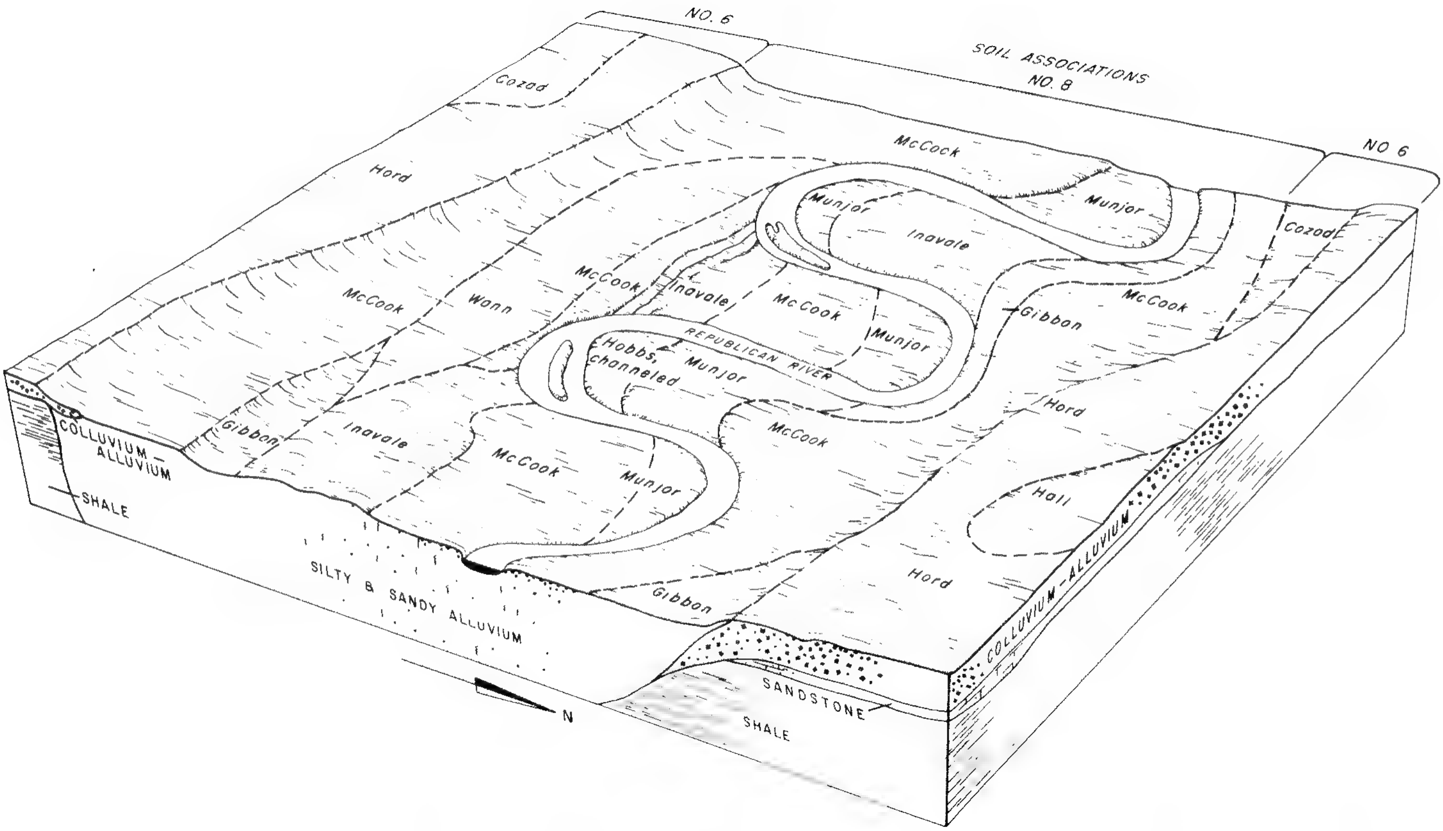


Figure 4.—**Pattern of soils and underlying material in Hord association and McCook-Wann-Inavale association (association 8).**

drained silty and loamy soils on bottom land and stream terraces

This association is on bottom land in the Little Blue River Valley, in valleys of several of the larger creeks, and on foot slopes adjacent to uplands. The soils are nearly level.

This association (see fig. 2, page 4) makes up about 11,000 acres, or 3 percent of the county. It is about 56 percent Hord soils, 19 percent Cass soils, 18 percent Hobbs soils, and 7 percent soils of minor extent.

Hord soils are on the higher parts of the bottom land and on stream terraces. They are well drained. They have a surface layer of silt loam. The subsoil is silt loam and the underlying material is noncalcareous silt loam.

Cass soils are on the lowest parts of the bottom land. They are well drained. They have a thick surface layer of loam. The upper part of the underlying material is mainly fine sandy loam, and the lower part is loamy sand that has some stratified lenses of sand. Most areas of these soils are flooded when the Little Blue River overflows.

Hobbs soils are on the lowest parts of bottom land. They are nearly level, occasionally flooded, and moderately well drained. They have a thick surface layer of silt loam. The underlying material is noncalcareous silt loam.

Less extensive in this association is Sandy alluvial land. Sandy alluvial land is in areas that are several feet above normal streamflow but are adjacent to the main channel of the river, where flooding is frequent.

Flooding from the main streams and tributaries is the main hazard. Maintaining high fertility and good tilth is an important concern of management.

Most farms on this association are the cash grain-livestock type. Nearly all areas are cultivated, except for small irregularly shaped areas that are in grass or trees or are used for pasture. Some areas are irrigated from wells or flowing streams. Corn, grain sorghum, and alfalfa are the main crops under both irrigated and dryland management. Wheat is seldom grown because of the flooding hazard. Some cattle and hogs are fattened in feedlots.

Farms on this association range from 120 to 640 acres in size. Gravel roads or improved dirt roads are on most section lines. Bridges crossing the Little Blue River and the main tributaries are not on all section lines. Farm produce, except livestock, is marketed mainly within the county. Some livestock is marketed locally, but most of it is shipped by truck to terminal markets, mainly Omaha.

8. *McCook-Wann-Inavale association*

Deep, nearly level, somewhat excessively drained to somewhat poorly drained silty, loamy, and sandy soils on bottom land

This association occupies bottom land in the Republican River Valley and Beaver Creek Valley. The nearly level soils formed in alluvium. The low lying areas and old stream channels are flooded for short periods after heavy rains. The water table fluctuates between depths of 2 and 10 feet.

This association (see figure 4, page 7) makes up 13,600 acres, or about 4 percent of the county. It is about 27 percent McCook soils, 20 percent Wann soils, 9 percent Inavale soils, and 44 percent soils of minor extent.

McCook soils are at intermediate elevations on bottom land. They are moderately well drained and calcareous. They have a thick silt loam or fine sandy loam surface layer. The transition layer and underlying material are very fine sandy loam.

Wann soils are at low elevations on the bottom land. They are somewhat poorly drained and have a water table at a depth of 2 to 5 feet. These soils are calcareous throughout the profile. They have a thick loam or fine sandy loam surface layer. The transition layer is very fine sandy loam or fine sandy loam, and the underlying material is fine sandy loam, loamy very fine sand, or loamy fine sand.

Inavale soils are on the low ridge and channel areas of the bottom land. They are somewhat excessively drained soils that have a thin surface layer of loamy fine sand and fine sandy loam. The underlying material is loamy sand, and in some areas it is stratified with lenses of coarser material. Some areas are flooded when the river overflows.

Minor in this association are Cozad, Hord, Gibbon, Hobbs, and Munjor soils and Sandy alluvial land. Cozad and Hord soils are on high stream terraces. The somewhat poorly drained Gibbon soils are on silty bottom land. The moderately well drained Munjor soils also are on bottom land. Hobbs soils and Sandy alluvial land are on low bottoms and in old stream channels where flooding is frequent.

Soil blowing, flooding, and wetness are the main hazards in cultivated areas. Maintaining high fertility is an important concern in irrigated areas. Farms are diversified. Most are the cash grain-livestock type. About 65 percent of the association is irrigated with water from canals or the Republican River, 20 percent is in grass and trees and is used for pasture, and the rest is in dryfarmed crops. Corn, grain sorghum, and alfalfa are the main irrigated and dryland crops. Some cattle and hogs are fattened in feedlots and marketed.

Farms on this association range mainly from 160 acres to 480 acres in size, but some are as large as 1,280 acres. Gravel or improved dirt roads are on most section lines. Some paved highways cross the association. Farm produce, except livestock, is marketed mainly within the county. Some livestock is marketed locally, but most of it is shipped to terminal markets, mainly Omaha.

Descriptions of the Soils

This section describes the soil series and mapping units in Nuckolls County. A soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for dry soil unless otherwise stated. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Sandy alluvial land, for example, does not belong to a soil series, but nevertheless is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, range site, and windbreak suitability group in which the mapping unit has been placed. The page for the description of each capability unit is indicated in the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual *(6)*.

A given soil series in this county may be identified by a different name in a recently published soil survey of an adjacent county. Some soil boundaries do not match those of adjoining areas. Differences result from changes in concepts of soil classification that have occurred since publication.

Butler Series

The Butler series consists of deep, somewhat poorly drained soils that have a compact clayey subsoil. These nearly level soils formed in silty loess in basinlike depressions of the uplands. They receive runoff from higher lying soils.

In a representative profile the surface layer is dark gray silt loam about 10 inches thick. Beneath this is a gray silt loam subsurface layer that is only 2 inches thick. The subsoil is about 31 inches thick. The upper part is dark gray, very firm silty clay, and the lower part is gray, firm silty clay loam. The underlying material is calcareous silt loam that is light brownish gray in the upper part and light gray to a depth of 60 inches.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Butler silt loam, 0 to 1 percent slopes	4,150	1.1
Cass loam, occasionally flooded, 0 to 2 percent slopes	2,100	.6
Cozad silt loam, 0 to 1 percent slopes	2,300	.6
Crete silt loam, 0 to 1 percent slopes	61,500	16.6
Fillmore silt loam, 0 to 1 percent slopes	1,100	.3
Fillmore silt loam, drained, 0 to 1 percent slopes	1,800	.5
Geary silt loam, 3 to 6 percent slopes	19,300	5.2
Geary silt loam, 6 to 11 percent slopes	2,850	.8
Geary silty clay loam, 3 to 6 percent slopes, eroded	2,850	.8
Geary silty clay loam, 6 to 11 percent slopes, eroded	10,600	2.9
Geary complex, 11 to 30 percent slopes	34,000	9.2
Geary complex, 11 to 30 percent slopes, severely eroded	3,850	1.0
Geary and Jansen silt loams, 3 to 6 percent slopes	1,000	.3
Geary and Jansen soils, 6 to 11 percent slopes, eroded	1,007	.3
Geary and Jansen soils, 11 to 30 percent slopes	2,350	.6
Gibbon silt loam, 0 to 1 percent slopes	1,260	.3
Hall silt loam, 0 to 1 percent slopes	4,050	1.1
Hall silt loam, terrace, 0 to 1 percent slopes	730	.2
Hastings silt loam, 0 to 1 percent slopes	38,250	10.3
Hastings silt loam, 1 to 3 percent slopes	38,400	10.4
Hastings silt loam, 3 to 6 percent slopes	45,750	12.3
Hastings silty clay loam, 3 to 6 percent slopes, eroded	3,800	1.0
Hobbs silt loam, channeled, 0 to 3 percent slopes	8,400	2.3
Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes	7,800	2.1
Holder silt loam, 1 to 3 percent slopes	972	.3
Holder silt loam, 3 to 6 percent slopes	12,800	3.5
Holder silt loam, 6 to 11 percent slopes	3,000	.8
Holder silty clay loam, 3 to 6 percent slopes, eroded	1,200	.3
Holder silty clay loam, 6 to 11 percent slopes, eroded	8,600	2.3
Hord silt loam, 0 to 1 percent slopes	14,500	3.9
Hord silt loam, 1 to 3 percent slopes	5,300	1.4
Hord silt loam, 3 to 6 percent slopes	550	.1
Inavale loamy fine sand, 0 to 2 percent slopes	890	.2
Inavale fine sandy loam, 0 to 2 percent slopes	495	.1
Kipson silt loam, 6 to 30 percent slopes	354	.1
Marsh	218	.1
McCook fine sandy loam, 0 to 2 percent slopes	2,100	.6
McCook silt loam, 0 to 1 percent slopes	1,600	.4
Meadin loam, 6 to 30 percent slopes	770	.2
Munjor soils, 0 to 2 percent slopes	1,200	.3
Saline-alkali land	176	[1]
Sandy alluvial land	600	.2
Scott silt loam, 0 to 1 percent slopes	166	[1]
Uly silt loam, 11 to 30 percent slopes	9,200	2.5
Uly silt loam, 11 to 30 percent slopes, eroded	1,750	.5
Wann fine sandy loam, 0 to 2 percent slopes	460	.1
Wann loam, 0 to 2 percent slopes	2,350	.6
Water area	1,880	.5
Gravel pit	232	.1
Total	370,560	100.0

[1] Less than 0.05 percent.

Permeability is slow, and available water capacity is high. These soils absorb moisture easily until the surface layer is saturated. After that, moisture is absorbed slowly. It is released slowly to plants. Natural fertility is medium.

Butler soils are suited to cultivated crops under both dryland and irrigated management. They are also suited to grass, trees, and shrubs and to all plants that provide habitat for wildlife.

Representative profile of Butler silt loam, 0 to 1 percent slopes, in cultivated field, 790 feet north and 100 feet west of southeast corner of sec. 9, T. 2 N., R. 6 W.

Ap—0 to 5 inches; dark gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A12—5 to 10 inches; dark gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure parting to moderate granular; soft, very friable; slightly acid; abrupt smooth boundary.

A2—10 to 12 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak thin platy structure; soft, friable; slightly acid; abrupt smooth boundary.

B21t—12 to 22 inches; dark gray (10YR 4/1) silty clay, very dark brown (10YR 2/2) moist; strong medium and coarse blocky structure; very hard, very firm; neutral; clear smooth boundary.

B22t—22 to 32 inches; dark gray (10YR 4/1) silty clay, very dark brown (10YR 2/2) moist; moderate medium and coarse blocky structure; very hard, very firm; mildly alkaline; clear smooth boundary.

B3—32 to 43 inches; gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) moist; moderate fine and medium subangular blocky structure; hard, firm; slight effervescence; moderately alkaline; clear smooth boundary.

C1—43 to 55 inches; light brownish gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure; soft, friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—55 to 60 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure; soft, friable; strong effervescence; moderately alkaline.

The A horizon is 9 to 15 inches thick. The B2t horizon is silty clay or clay 12 to 26 inches thick. It is 45 to 55 percent clay. Depth to lime ranges from 28 to 50 inches.

Butler soils are near Crete, Hastings, and Fillmore soils. They differ from Crete soils in having a well defined A2 horizon. They differ from Hastings soils in having an A2 horizon and more clay in the B2t horizon. They have a thinner A2 horizon than Fillmore soils.

Bu—Butler silt loam, 0 to 1 percent slopes. This soil is in irregularly shaped, slightly depressed areas of the uplands. Runoff from adjacent higher areas of Crete and Hastings soils accumulates on this soil for short periods. In a few small areas the subsoil is not so clayey as is typical for Butler soils. Included in mapping were small areas of Fillmore and Scott soils on the lowest part of the landscape.

This soil compacts readily if it is worked or grazed when wet. Organic-matter content is moderate. Temporary ponding of water frequently delays fieldwork. This soil is suited to irrigation, but requires smaller and more frequent applications of water than soils having a more permeable subsoil. Land leveling is commonly needed to improve surface drainage. Drought is a hazard under dryland management. Root penetration is restricted in the dense clayey subsoil.

Most of the acreage is cultivated. Dryland crops are chiefly wheat and grain sorghum. Corn is the main irrigated crop. Capability units IIw-2 dryland, IIw-2 irrigated; Clayey range site; windbreak suitability group 2.

Cass Series

The Cass series consists of deep, nearly level, well drained soils. These soils are on bottom land mainly along the Big Blue River. They formed in recent alluvium. Depth of the water table ranges from 5 to 10 feet.

In a representative profile the surface layer is loam 11 inches thick. The upper part is grayish brown, and the lower part is dark grayish brown. Beneath this is a transition layer of grayish brown fine sandy loam about 19 inches thick. In sequence downward, the underlying material to a depth of 60 inches is light brownish gray loamy very fine sand, pale brown loam, and light brownish gray loamy coarse sand.

Permeability is moderately rapid, and available water capacity is moderate. Natural fertility is medium to low. Moisture is readily released to plants. These soils are subject to occasional flooding.

Cass soils are suited to cultivated crops. They are well suited to irrigation, but are not extensively irrigated because of the hazard of overflow. They are also suited to grass and to tree and shrub plantings. Many areas provide good habitat for wildlife. Some areas close to streams are in wooded pasture.

Representative profile of Cass loam, occasionally flooded, 0 to 2 percent slopes, in a cultivated field, 525 feet south and 150 feet east of the northwest corner of sec. 23, T. 3 N., R. 5 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; medium acid; abrupt smooth boundary.

A12—5 to 11 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; soft, very friable; medium acid; clear smooth boundary.

AC—11 to 30 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine and medium subangular blocky structure; thin stratified layers of coarser and finer textured material; soft, very friable; slightly acid; clear smooth boundary.

C1—30 to 38 inches; light brownish gray (10YR 6/2) loamy very fine sand, brown (10YR 5/3) moist; single grained; loose; slightly acid; abrupt smooth boundary.

C2—38 to 48 inches; pale brown (10YR 6/3) loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; neutral; abrupt smooth boundary.

C3—48 to 60 inches; light brownish gray (10YR 6/2) loamy coarse sand, dark grayish brown (10YR 4/2) moist; single grained; loose; neutral.

The A horizon ranges from 10 to 18 inches in thickness. It is dominantly loam, but in small areas is fine sandy loam. The C horizon is stratified material generally becoming coarser textured with increasing depth, but strata of silty material occur in places. In places brownish mottles are below a depth of 40 inches.

Cass soils are near Hord and Hobbs soils. They contain more sand throughout the profile than Hord and Hobbs soils. The A horizon is thinner than that of Hord soils.

Ca—Cass loam, occasionally flooded, 0 to 2 percent slopes. This soil is on bottom land that is flooded once or twice each year about 3 out of every 5 years. Areas are commonly long and narrow and parallel the major streams. Included in mapping were small areas at the higher elevations where the surface layer is fine sandy loam.

This soil is very friable and is easily tilled. Crops can be damaged by floodwater if it flows too rapidly. Silt and sand are deposited in places as the water recedes. Organic-matter content is moderate. Runoff is slow. Under dryland management, this soil is droughty, particularly late in summer.

Most of the acreage is cultivated. Dryland crops are chiefly grain sorghum, corn, and alfalfa. Wheat is not grown extensively because of the hazard of flooding in spring. Grain sorghum and corn are the main irrigated crops. Capability units IIw-3 dryland, IIw-8 irrigated; Sandy Lowland range site; windbreak suitability group 1.

Cozad Series

The Cozad series consists of deep, nearly level, well drained soils. These soils formed in medium textured alluvium on high bottom land in the Republican River Valley.

In a representative profile the surface layer is silt loam about 10 inches thick. It is dark gray in the upper part and dark grayish brown in the lower part. The subsoil is very friable, grayish brown silt loam about 10 inches thick. The underlying material is light brownish gray, calcareous silt loam to a depth of 60 inches.

Permeability is moderate, and available water capacity is high. Natural fertility is high. Tilth is good, and the soils are easy to work. The soils absorb moisture easily and release it readily to plants.

Cozad soils are suited to cultivated crops under both dryland and irrigated management. They are also suited to grass, trees, and shrubs and to all plants that provide habitat for wildlife.

Representative profile of Cozad silt loam, 0 to 1 percent slopes, in a cultivated field, 2,640 feet west and 800 feet south of the northeast corner of sec. 31, T. 1 N., R. 7 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A12—6 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure parting to weak medium granular; slightly hard, very friable; neutral; clear smooth boundary.

B2—10 to 20 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; mildly alkaline; clear smooth boundary.

C—20 to 60 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; slight effervescence; moderately alkaline.

The A horizon is 10 to 15 inches thick. Color ranges from dark gray to grayish brown. The B2 horizon is dominantly silt loam, but in places is loam or very fine sandy loam. Depth to carbonates averages about 28 inches, but ranges from 19 to 50 inches.

Cozad soils are near McCook, Wann, and Munjor soils. Cozad soils have less sand in the C horizon than McCook soils. They have more silt throughout the solum than Wann and Munjor soils. They are better drained than Wann soils.

Co—Cozad silt loam, 0 to 1 percent slopes. This soil is on high bottom land. Areas range from 20 to 400 acres in size. Included in mapping were small areas of McCook and Wann soils at the lower elevations. Also included were strips near irrigation canals where the water table rises to within 3 to 5 feet of the surface during irrigation of this soil.

Organic-matter content is moderate. Runoff is slow. This soil absorbs moisture well and releases it readily to plants.

Nearly all the acreage is cultivated, and much of it is irrigated. The chief dryland crops are corn, grain sorghum, alfalfa, and wheat. Corn and grain sorghum are the main irrigated crops. Capability units I-1 dryland, I-6 irrigated; Silty Lowland range site; windbreak suitability group 1.

Crete Series

The Crete series consists of deep, nearly level, moderately well drained soils. These soils formed in loess on uplands.

In a representative profile (fig. 5) the surface layer is about 14 inches thick. It is gray silt loam in the upper part, dark gray silt loam in the middle part, and dark gray light silty clay loam in the lower part. The subsoil is about 26 inches thick. It is dark grayish brown, firm silty clay in the upper part; grayish brown, firm silty clay in the middle part; and pale brown, friable silty clay loam in the lower part. The underlying material is very pale brown, calcareous silt loam to a depth of 60 inches.

Permeability is slow, and available water capacity is high. Natural fertility is medium or high. The silty clay subsoil causes these soils to absorb water slowly. As a result the soils are somewhat droughty, particularly under dryland management. Water is released slowly to plants.

Crete soils are suited to cultivated crops under both dryland and irrigated management. They are irrigated where sufficient water is available. They are suited to grass, plantings of trees and shrub, and to all plants that provide habitat for wildlife.

Representative profile of Crete silt loam, 0 to 1 percent slopes, in a cultivated field, 1,050 feet north and 100 feet east of the southwest corner of sec. 13, T. 4 N., R. 5 W.

Ap—0 to 5 inches; gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A12—5 to 11 inches; dark gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; moderate medium and coarse granular structure; soft, very friable; slightly acid; clear smooth boundary.

Figure 5.—Profile of Crete silt loam.

A13—11 to 14 inches; dark gray (10YR 4/1) light silty clay loam, very dark grayish brown (10YR 3/2) moist; strong medium and coarse granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

B21t—14 to 26 inches; dark grayish brown (10YR 4/2) silty clay, dark brown (10YR 3/3) moist; strong fine and medium blocky structure; hard, firm; neutral; clear smooth boundary.

B22t—26 to 32 inches; grayish brown (10YR 5/2) silty clay, dark brown (10YR 4/3) moist; strong medium and coarse blocky structure; hard, firm; neutral; clear smooth boundary.

B3t—32 to 40 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; moderate medium and coarse subangular blocky structure; hard, friable; common medium soft masses of lime; strong effervescence; mildly alkaline; clear smooth boundary.

C1—40 to 52 inches; very pale brown (10YR 7/3) silt loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable; common medium soft masses of lime; strong effervescence; mildly alkaline; clear wavy boundary.

C2—52 to 60 inches; very pale brown (10YR 7/3) silt loam, light olive brown (2.5Y 5/4) moist; common medium distinct mottles, yellowish brown (10YR 5/6) moist; massive; slightly hard, friable; slight effervescence; mildly alkaline.

The A horizon ranges from 11 to 20 inches in thickness. The B2t horizon is 45 to 52 percent clay. In places the B2t horizon has organic and clay coatings on the vertical and horizontal faces of peds, which are generally darker than the interior of the peds. Depth to the soft lime ranges from 25 to 50 inches.

Crete soils are near Hastings, Butler, and Geary soils. The B2t horizon contains more clay than that of Hastings and Geary soils. Crete soils are better drained than Butler soils and, unlike those soils, have no A2 horizon and no abrupt textural change between the A and B horizons.

Cr—Crete silt loam, 0 to 1 percent slopes. This soil is on the loess uplands. Areas range from 20 to about 3,000 acres. Included in mapping were small areas of Butler soils in shallow basins and areas of Hastings soils at slightly higher elevations. Also included were small areas of soils that have less clay in the subsoil than is typical of Crete soils.

This soil puddles readily if worked or trampled when wet, but retains its good structure if well managed. Organic-matter content is moderate. Runoff is slow. Drought is a hazard because the fine textured subsoil releases water slowly to plants.

Most of the acreage is cultivated, and much of it is irrigated. In dryfarmed areas this soil is better suited to wheat and sorghum than to corn. All crops, especially corn, respond well to irrigation. Capability units IIs-2 dryland, IIs-2 irrigated; Clayey range site; windbreak suitability group 4.

Fillmore Series

The Fillmore series consists of deep, poorly drained soils. These soils have a compact subsoil that is clayey in the upper part and silty in the lower part. They formed in silty loess in shallow depressions of the uplands. They receive runoff from surrounding soils and are ponded for short periods after heavy rains.

In a representative profile the surface layer is gray silt loam about 7 inches thick. Beneath this is a light gray silt loam subsurface layer 4 inches thick. The subsoil is about 36 inches thick. The upper part is dark gray, firm silty clay; the next part is gray, firm silty clay; and the lower part is grayish brown, friable light silty clay loam. The underlying material is light brownish gray, calcareous silt loam to a depth of 60 inches.

These soils absorb water very slowly and release it slowly to plants. Permeability is very slow, and available water capacity is high. Natural fertility is medium.

Fillmore soils are suited to cultivated crops under both dryland and irrigated management. They are also suited to grass, trees, and shrubs and to all plants that provide habitat for wildlife.

Representative profile of Fillmore silt loam, 0 to 1 percent slopes, in native vegetation, 900 feet east and 100 feet south of northwest corner of sec. 9, T. 4 N., R. 5 W.

A1—0 to 7 inches; gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; moderate thin platy structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A2—7 to 11 inches; light gray (10YR 7/1) silt loam, gray (10YR 5/1) moist; weak thin platy structure; soft, very friable; slightly acid; abrupt smooth boundary.

B21t—11 to 20 inches; dark gray (10YR 4/1) silty clay, very dark grayish brown (10YR 3/2) moist; strong fine and medium blocky structure; few small pellets (iron or manganese); very hard, firm; neutral; clear smooth boundary.

B22t—20 to 31 inches; gray (10YR 5/1) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse blocky structure; few small pellets (iron or manganese); hard, firm; mildly alkaline; clear smooth boundary.

B3—31 to 47 inches; grayish brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; hard, friable; strong effervescence; moderate alkaline; gradual smooth boundary.

C—47 to 60 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; slight effervescence; moderately alkaline.

The A1 horizon is 5 to 12 inches thick, and the A2 horizon 4 to 8 inches thick. The B2t horizon is 45 to 55 percent clay. Iron or manganese pellets 1 to 3 millimeters in diameter are common in the B2t horizon in most areas. Mottles occur in the lower part of the B horizon and in the C horizon of some areas. Thickness of the solum ranges from 40 to 60 inches. Depth to free lime ranges from 36 to more than 60 inches; it is commonly below 42 inches.

Fillmore soils are near Butler, Crete, Hastings, and Scott soils. They are more poorly drained than Butler, Crete, and Hastings soils. They have more clay in the B2t horizon than Hastings soils. They differ from Crete soils in having an A2 horizon. Fillmore soils have a thicker A2 horizon than Scott soils.

Fm—Fillmore silt loam, 0 to 1 percent slopes. This soil is in shallow depressions of the uplands. It has the profile described as representative of the series. It generally occurs as roughly oval shaped areas that range from 5 to 50 acres in size. Included in mapping were small areas of Butler soils at the higher elevations and Scott soils in the lower areas.

The major hazard is excess water that accumulates as a result of runoff from adjacent areas, following heavy rains. Some crop damage can be expected in most years. Crop damage is extensive about 1 year out of 5, unless adequate drainage outlets are provided. Wetness caused by flooding in spring delays seedbed preparation and planting. Organic-matter content is moderate. Runoff is very slow or ponded. Drought is a hazard under dryland management because during periods of low rainfall root penetration is restricted in the dense clayey subsoil.

Most of the acreage is cultivated. Dryland crops are chiefly grain sorghum and wheat and a limited acreage of corn. Corn and grain sorghum are the main irrigated crops. Capability units IIIw-2 dryland, IIIw-2 irrigated; Clayey Overflow range site; windbreak suitability group 6.

Fo—Fillmore silt loam, drained, 0 to 1 percent slopes. This soil is in areas that were shallow basins before they were filled and leveled. Providing adequate surface drainage is commonly a part of the land grading for irrigation development. As a result of improved surface drainage, this soil is moderately well drained. It has a profile similar to the one described as representative of the series, but the surface layer is thicker. Areas are roughly oval in shape and range from 5 to 70 acres in

size. Included in mapping were small areas where Butler and Scott soils also have been graded, filled, and leveled.

Under dryland management, this soil is somewhat droughty during periods of low rainfall. Water movement is very slow and root penetration is restricted in the compact clayey subsoil. During wet seasons the surface layer remains saturated for longer periods than that of adjacent associated soils because of the very slowly permeable subsoil. Runoff is slow. Organic-matter content is moderate.

Nearly all the acreage is cultivated and irrigated. Grain sorghum and corn are the main irrigated crops. Capability units IIw-2 dryland, IIw-2 irrigated; Clayey range site; windbreak suitability group 2.

Geary Series

The Geary series consists of deep, well drained soils on uplands. These gently sloping to steep soils formed in silty loess.

In a representative profile (fig. 6) the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is about 28 inches thick. The upper part is grayish brown, friable light silty clay loam; the next part is brown, firm silty clay loam; and the lower part is reddish yellow, firm silty clay loam. The underlying material is reddish yellow, calcareous heavy silt loam to a depth of 60 inches.

Permeability is moderately slow, and available water capacity is high. Natural fertility is high or medium.

The less sloping areas of Geary soils are suited to cultivated crops. The steeper areas are suited to grass and are used mainly as range. Geary soils are suited to tree and shrub plantings for windbreaks and to production of habitat for openland wildlife.

Representative profile of Geary silt loam, 3 to 6 percent slopes, in native grass, 800 feet south and 50 feet east of northwest corner of sec. 3, T. 2 N., R. 5 W.

A—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate thin and medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B1—10 to 15 inches; grayish brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

B2t—15 to 29 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate medium and coarse subangular blocky structure; hard, firm; neutral; clear smooth boundary.

B3—29 to 38 inches; reddish yellow (7.5YR 6/6) silty clay loam, brown (7.5YR 5/4) moist; moderate medium and coarse subangular blocky structure; hard, firm; neutral; clear gradual boundary.

C—38 to 60 inches; reddish yellow (7.5YR 6/6) heavy silt loam, brown (7.5YR 5/4) moist; few medium distinct mottles, yellowish brown (10YR 5/6) moist; accumulations of soft, small masses of lime; weak coarse prismatic structure; slightly hard, friable; strong effervescence; neutral.

The A horizon ranges from 8 to 13 inches in thickness. The B2t horizon is silty clay loam or heavy silt loam 18 to 28 inches thick. The C horizon is dominantly heavy silt loam, but in places it is silty clay loam. Depth to lime ranges from 40 to 60 inches.

Geary soils are near Hastings, Holder, and Jansen soils. They have less clay in the B2t horizon than Hastings soils.

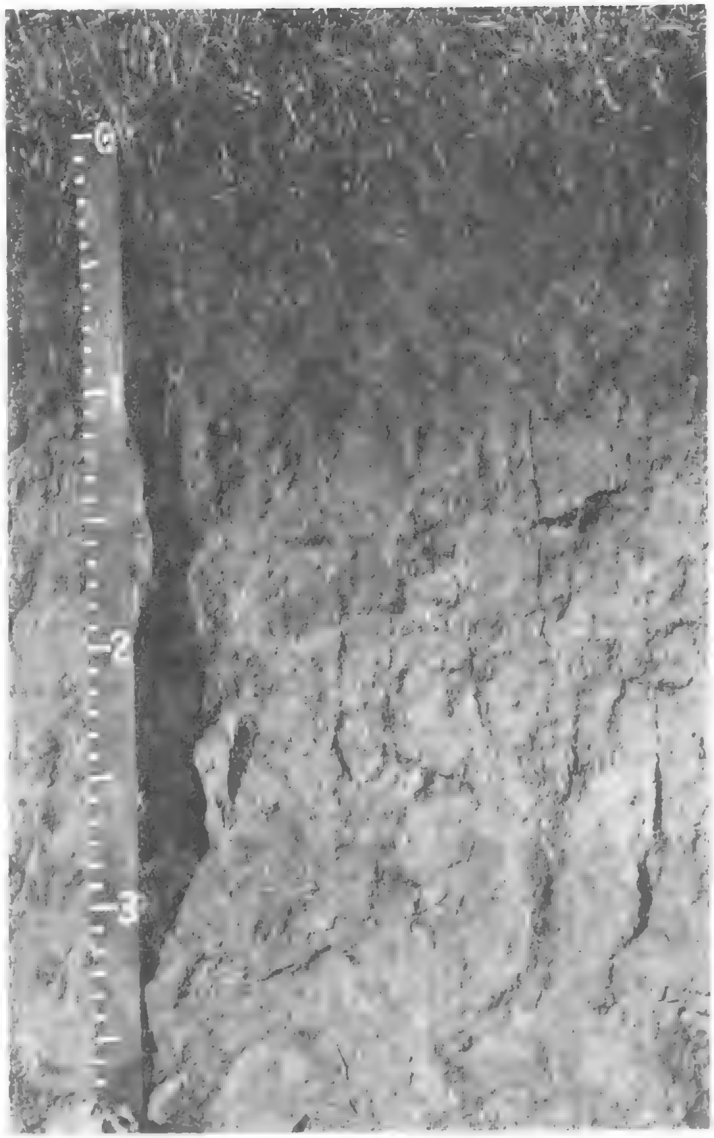


Figure 6.—Profile of Geary silt loam. This deep, well drained soil formed in loess of the Loveland Formation.

They have a redder C horizon than Holder soils. They have a silty C horizon, whereas Jansen soils have a C horizon of mixed, coarse sand and gravel.

GaC—Geary silt loam, 3 to 6 percent slopes. This soil is on the ridgetops and short side slopes that border upland drainageways. Areas are long and narrow, generally following the contour of the hillside. They range from 5 to 60 acres in size.

This soil has the profile described as representative of the series. In some small areas, however, the soil is eroded and the surface layer is only 6 inches thick. In some small areas the surface layer is silty clay loam.

Included with this soil in mapping in the southwestern part of the county were small areas of a soil similar to this soil, but the subsoil is not so fine textured. Also included were areas of Hastings and Holder soils.

This soil absorbs moisture readily. Runoff is medium. Water erosion is the main hazard. Organic-matter content is moderate.

Most of the acreage is cultivated. Grain sorghum, wheat, corn, and alfalfa are the main dryland crops. About 30 percent of the acreage is in native grass. Capability units IIIe–1 dryland, IIIe–4 irrigated; Silty range site; windbreak suitability group 4.

GaD—Geary silt loam, 6 to 11 percent slopes. This soil is on ridgetops and hillsides on uplands. Areas range from 20 to 120 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are slightly thinner. The surface layer is slightly lighter colored and thinner in cultivated areas than in native grass areas.

Included with this soil in mapping were small areas of Hastings silt loam and Holder silt loam. Also included in the southwestern part of the county is a soil similar to this Geary soil, but the subsoil is not so fine textured.

Runoff is medium to rapid, depending on the amount of vegetation. Water erosion is a severe hazard in cultivated areas. Organic-matter content is medium.

Most of the acreage is in grass and is used as range or for hay. A small acreage is in dryland crops, mainly wheat, alfalfa, and grain sorghum. Capability units IVe–1 dryland, IVe–4 irrigated; Silty range site; windbreak suitability group 4.

GeC2—Geary silty clay loam, 3 to 6 percent slopes, eroded. This soil is on ridges and short side slopes in areas that border upland drainageways. Areas range from 10 to 40 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored and is silty clay loam. Most of the original surface layer has been removed by water erosion. The rest has been mixed with the upper part of the subsoil by tillage. The present surface layer is brown or grayish brown.

Included with this soil in mapping were small areas of eroded Hastings silty clay loam and eroded Holder silty clay loam. In some areas of this soil in the southwestern part of the county, the subsoil is silt loam or only light silty clay loam. In severely eroded areas the surface layer is reddish yellow. Between 10 and 30 percent of this mapping unit is a Geary silt loam that has a dark grayish brown surface layer.

The surface layer is firm. The slope and the compactness of the soil make runoff rapid. Water erosion is a severe hazard in cultivated areas. In some areas rills and crossable gullies have formed. Organic-matter content is moderately low.

Most of the acreage is cultivated. The soil is suited to most of the commonly grown dryland crops. A few areas have been seeded to native grasses. Capability units IIIe–8 dryland, IIIe–3 irrigated; Silty range site; windbreak suitability group 4.

GeD2—Geary silty clay loam, 6 to 11 percent slopes, eroded. This soil is on short side slopes at the upper ends of drainageways and on hillsides and ridgetops of the uplands. Areas range from 20 to about 80 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored and is silty clay loam. Erosion has removed most of the original darkened surface layer and in places has also removed part of the subsoil. Tillage has mixed the rest of the surface layer with the upper part of the subsoil. The surface layer is mostly grayish brown or brown. In some areas in the southwestern part of the country, the subsoil is silt loam or only a light silty clay loam. In many areas where erosion has been most severe, the surface layer is reddish yellow.

Included with this soil in mapping were small areas of eroded Hastings silty clay loam. Between 5 to 20 percent of this mapping unit is Geary silt loam.

The slope and the compactness of the soil make runoff rapid. Water erosion is the main hazard. Many rills and small crossable gullies have formed. Organic-matter content is moderate to low. Fertility is lowest where the soil is most severely eroded.

Most of the acreage is cultivated. A few areas are seeded to native grass. Wheat, alfalfa, corn, and grain sorghum, the most commonly grown crops, are mainly dryfarmed. Capability units IVe–8 dryland, IVe–3 irrigated; Silty range site; windbreak suitability group 4.

GfF—Geary complex, 11 to 30 percent slopes. This mapping unit is on hillsides and along the short side slopes of upland drainageways. It is about 65 percent Geary soil, 25 percent Uly soil, and 10 percent Hobbs soil. Geary silt loam is on the lower part of upland side slopes bordering the drainageways. Uly silt loam is on hillsides above the Geary soil, and Hobbs silt loam is on narrow strips of bottom land along intermittent drainageways. Areas range from 20 to 600 acres in size.

Geary and Uly soils have profiles similar to the ones described as representative of their respective series, but the surface layer and subsoil are slightly thinner and the underlying loess is exposed in some of the steeper areas. The steeper slopes are not smooth, but have a catstep appearance. The Hobbs soil is nearly level. In the southwestern part of the county, the soils are not so fine textured as the typical Geary soil.

Included with this unit in mapping were small areas where slopes are 30 to 45 percent. Also included were small areas of the strongly sloping Hastings silt loam and Holder silt loam.

Runoff is rapid to very rapid depending on the amount of vegetation. Water erosion is a very severe hazard. Sand and gravel crops out in small areas on the lower part of some steep slopes. The organic-matter content is moderately low.

Nearly all the acreage is in native grass and is used as range. The slope is too steep for the commonly grown crops. Trees and small shrubs are common on the steeper slopes near the lower ends of the drainageways. Capability unit VIe–1 dryland; Silty range site; windbreak suitability group 10.

GfF3—Geary complex, 11 to 30 percent slopes, severely eroded. This mapping unit is on hillsides and in areas that border drainageways. It is about 70 percent Geary silt loam and Geary silty clay loam and 30 percent Uly silt loam. The Geary soil is on the lower side slopes and hillsides, and the Uly soil is on ridge-

tops and upper hillsides above the Geary soil. Areas are irregular in shape and range from 5 to 40 acres in size.

Geary soils have profiles similar to the ones described as representative of the Geary series, but Geary silty clay loam is thinner and has a lighter colored surface layer that also differs in texture. Uly silt loam has a profile similar to the one described as representative of the Uly series, but the surface layer and subsoil are thinner and lighter colored. In the southwestern part of the county, the subsoil of the Geary soils is silt loam or light silty clay loam. In places the reddish yellow underlying material of the Geary soils is exposed. Between 5 and 25 percent of this mapping unit is on an uneroded Geary silt loam.

Included in this unit in mapping were small areas of an eroded Hastings silty clay loam and an eroded Holder silty clay loam on the upper hillsides and on ridgetops. Also included were small areas of Hobbs silt loam on the bottoms of narrow drainageways.

Runoff is rapid, and water erosion is a very severe hazard. Small gullies and rills have formed in cultivated areas. Organic-matter content is moderate to low.

This mapping unit is too steep for the commonly grown cultivated crops. It is better suited to grass. Nearly all the acreage has been cultivated. About one-third has been seeded to native grasses. Capability unit VIe–8 dryland; Silty range site; windbreak suitability group 10.

GgC—Geary and Jansen silt loams, 3 to 6 percent slopes. This mapping unit is on low ridges and side slopes of uplands. In most areas both soils occur in varying proportions, but a few areas are entirely of one of these soils. The Geary soil is typically above the Jansen soil, but in some areas it formed in material downslope from that soil, as a result of erosion. Areas range from 10 to 80 acres in size.

The Geary soil has a profile similar to the one described as representative of the Geary series. The Jansen soil has the profile described as representative of the Jansen series. In a few places the subsoil of both soils is silty clay loam. Included in mapping were small areas of Holder and Meadin soils.

Runoff is medium. Water erosion is severe in cultivated areas. Organic-matter content is moderately low to moderate.

Most of the acreage is in cultivated crops, mainly grain sorghum and wheat. About 35 percent is in native grasses and is used as range. Capability units IIIe–1 dryland, IIIe–7 irrigated; Silty range site; Geary soil in windbreak suitability group 4, Jansen soil in windbreak suitability group 5.

GhD2—Geary and Jansen soils, 6 to 11 percent slopes, eroded. This mapping unit is on side slopes and ridgetops in uplands. In most areas both soils occur in equal proportions, but some areas are mainly Geary soil and others are mainly Jansen soil. The Geary soil is typically above the Jansen soil, but in some areas it formed in material washed downslope from that soil. Areas range from 5 to 40 acres in size.

Both soils have profiles similar to the ones described as representative of their respective series, but the surface layer is thinner and slightly lighter colored. On 5 to 25 percent of the acreage, the surface layer is dark grayish brown and 7 to 12 inches thick. The Geary soil has a silt loam or silty clay loam surface layer. In some areas the subsoil of the Jansen soil is silty clay loam. Included in mapping were small areas of Holder and Meadin soils.

Runoff is medium to rapid, depending on the amount of vegetation. Water erosion is severe in cultivated areas. Organic-matter content is low to moderately low. Available water capacity is high in the Geary soil and low in the Jansen soil.

Most of the acreage is cultivated to dryland crops, mainly wheat and grain sorghum. A few areas are in native grasses. This unit is suited to irrigated crops, but high level management is needed. Capability units IVe–8 dryland, IVe–7 irrigated; Silty range site; Geary soil in windbreak suitability group 4, Jansen soil in windbreak suitability group 5.

GhF—Geary and Jansen soils, 11 to 30 percent slopes. This mapping unit is on side slopes of the uplands. In most areas the Geary soil and the Jansen soil occur in about equal proportions, but a few areas are mainly Geary soil and others are mainly Jansen soil. The Geary soil is typically above the Jansen soil. Areas range from 10 to 100 acres in size.

Both soils have profiles similar to the ones described as representative of their series. The surface layer of the Geary soil is mainly silt loam, but in a few places is silty clay loam. The surface layer of the Jansen soil is mainly silt loam, but in a few areas is clay loam.

Included with this unit in mapping were areas that are as much as 25 percent Meadin soils. Also included were small areas of Hobbs soils on narrow bottoms of intermittent drainageways.

Runoff is rapid, and water erosion is very severe. Organic-matter content is moderately low. Available water capacity is high in the Geary soil and low in the Jansen soil.

This unit is too steep for cultivation of the commonly grown crops. Most of the acreage is in native grasses and is used as range. The Geary soil supports a fair to good cover of mid and tall native grasses. The Jansen soil and the included Meadin soil, however, are more droughty, and the plant cover is sparse, particularly in the Meadin soil areas. Capability unit VIe–1 dryland; Silty range site; windbreak suitability group 10.

Gibbon Series

The Gibbon series consists of deep, nearly level, somewhat poorly drained soils. These soils formed in calcareous alluvial sediment on bottom land in the Republican River Valley. They are in slightly depressed areas below breaks in stream terraces. The water table fluctuates within a depth of 2 feet in spring and 6 feet in fall.

In a representative profile the surface layer is silt loam about 19 inches thick. The upper part is gray, and the lower part is dark gray. Beneath this is a transition layer of gray silt loam about 11 inches thick. The underlying material is light gray very fine sandy loam to a depth of 60 inches.

Permeability is moderate, and available water capacity is high. Natural fertility is medium to high. Mois-

ture is absorbed easily and released readily to plants. These soils are subject to flooding after heavy rains.

Gibbon soils are suited to cultivated crops. They are not extensively irrigated because they are subirrigated by the water table. They are suited to grass and to tree and shrub plantings. Some areas furnish good habitat for wildlife. Some areas near streams are in wooded pasture.

Representative profile of Gibbon silt loam, 0 to 1 percent slopes, in grass, 2,640 feet east and 100 feet north of southwest corner of sec. 8, T. 1 N., R. 8 W.

A11—0 to 7 inches; gray (10YR 5/1) heavy silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse granular structure; hard, friable; neutral; clear smooth boundary.

A12—7 to 13 inches; gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, friable; slight effervescence; neutral; clear smooth boundary.

A13—13 to 19 inches; dark gray (10YR 4/1) heavy silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse granular structure; slightly hard, friable; slight effervescence; moderately alkaline; clear smooth boundary.

AC—19 to 30 inches; gray (10YR 6/1) silt loam, gray (10YR 5/1) moist; weak fine and moderate subangular blocky structure; slightly hard, very friable; strong effervescence; strongly alkaline; clear smooth boundary.

C—30 to 60 inches; light gray (10YR 7/2) very fine sandy loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable; slight effervescence; strongly alkaline.

The A horizon ranges from 8 to 20 inches in thickness. Color ranges from dark grayish brown to gray. The AC horizon is dominantly silt loam, but in a few areas it is clay loam and in some it is a thin layer of loam and very fine sandy loam. In some areas the A and C horizons contain small masses of soft lime. The C horizon is typically very fine sandy loam, but in places it is silt loam. Depth to lime is less than 10 inches.

Gibbon soils are near McCook and Wann soils. They have more clay between depths of 10 and 40 inches than McCook soils and are not so well drained as those soils. They have less sand in the AC and C horizons than Wann soils.

Gn—Gibbon silt loam, 0 to 1 percent slopes. This soil is on bottom land. Areas are irregular in shape and range in size from 10 to 100 acres. Included in mapping were small areas of slightly higher lying McCook soils.

This soil is difficult to till during and just after wet periods. Some local flooding follows heavy rains. The surface layer is friable and is easily tilled if it is moist. The water table is highest in spring, and tillage and planting are commonly delayed. Organic-matter content is moderate. Runoff is slow.

Most of the acreage is cultivated. The rest is in native grass and is used for hay or grazing. Grain sorghum, corn, and alfalfa are the chief dryland crops. In the few irrigated areas, grain sorghum and corn are the main crops. Capability units IIw-4 dryland, IIw-6 irrigated; Subirrigated range site; windbreak suitability group 2.

Hall Series

The Hall series consists of deep, nearly level, well drained soils. These soils formed in loess on uplands and in alluvium on stream terraces along the Republican River and the Little Blue River Valleys.

In a representative profile the surface layer is gray silt loam about 17 inches thick. The subsoil is about 28 inches thick. It is grayish brown, very friable heavy silt loam in the upper part; grayish brown and brown, firm silty clay loam in the next part; and pale brown, friable silty clay loam in the lower part. The underlying material is very pale brown silt loam to a depth of 60 inches.

Permeability is moderately slow, and available water capacity is high. Natural fertility is high.

Hall soils are suited to cultivated crops under both dryland and irrigated management. They are extensively irrigated where sufficient water is available. They are suited to grass, to tree and shrub plantings, and to all plants that provide habitat for wildlife.

Representative profile of Hall silt loam, 0 to 1 percent slopes, in a cultivated field, 530 feet east and 50 feet south of northwest corner of sec. 18, T. 4 N., R. 8 W.

Ap—0 to 5 inches; gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A12—5 to 17 inches; gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B1—17 to 25 inches; grayish brown (10YR 5/2) heavy silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B21t—25 to 31 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; hard, firm; neutral; clear smooth boundary.

B22t—31 to 40 inches; brown (10YR 5/3) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse subangular blocky structure; hard, firm; neutral; clear smooth boundary.

B3t—40 to 45 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; moderate medium and coarse subangular blocky structure; hard, friable; neutral; clear smooth boundary.

C1—45 to 57 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak medium and coarse prismatic structure; slightly hard, very friable; neutral; clear smooth boundary.

C2—57 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; fine distinct mottles, yellowish brown (10YR 5/6) moist; massive; slightly hard, very friable; strong effervescence; mildly alkaline.

The A horizon is 12 to 18 inches thick. The B2t horizon is silty clay loam. In some thin layers it is as much as 40 percent clay. The clay content averages between 28 and 35 percent. Thickness of the solum ranges from 36 to 52 inches. Lime is generally below a depth of 50 inches.

Hall soils are near Hastings and Holder soils on the uplands and near Hord soils on the stream terraces. They have a thicker A horizon and less clay in the B2t horizon than Hastings soils. They have more clay in the B2 horizon than Holder and Hord soils.

Ha—Hall silt loam, 0 to 1 percent slopes. This soil is on broad divides of the loess upland. Areas range in size from 30 to 300 acres. This soil has the profile described as representative of the series. Included in mapping were small areas of nearly level Hastings silt loam at slightly higher elevations.

This soil absorbs moisture well and readily releases it to plants. It is easily worked. Lack of sufficient moisture is the main limitation in dryfarmed areas. Organic-matter content is moderate. Runoff is medium.

Nearly all the acreage is cultivated. The main crops are dryland grain sorghum, wheat, and alfalfa. Only limited acreage is irrigated. Sufficient underground water is not generally available for irrigation. Corn and grain sorghum are the main irrigated crops. Capability units I–1 dryland, I–4 irrigated; Silty range site; windbreak suitability group 4.

Hb—Hall silt loam, terrace, 0 to 1 percent slopes. This soil is on alluvial stream terraces. Areas range in size from 10 to 60 acres. Included in mapping were a few small areas of nearly level Hord silt loam. Also included were a few areas of a soil having a finer textured subsoil than is typical.

This soil absorbs moisture well and releases it readily to plants. Lack of sufficient moisture is the main limitation in dryfarmed areas. Organic-matter content is moderate. Runoff is medium.

This soil is well suited to cultivated crops. Most of the acreage is irrigated with water from canals. The chief irrigated crops are corn, grain sorghum, and alfalfa. Dryland crops are mainly grain sorghum and wheat. Capability units I–1 dryland, I–4 irrigated; Silty Lowland range site; windbreak suitability group 1.

Hasting Series

The Hastings series consists of deep, nearly level to gently sloping, well drained soils. These soils formed in loess on uplands.

In a representative profile (fig. 7) the surface layer is dark grayish brown silt loam about 11 inches thick. The subsoil is about 22 inches thick. The upper part is grayish brown, friable light silty clay loam; the next part is grayish brown, friable silty clay loam; and the lower part is pale brown, friable silty clay loam. The underlying material is very pale brown silt loam to a depth of 60 inches. It is calcareous in the lower part and is easily penetrated by roots.

Permeability is moderately slow, and available water capacity is high. Natural fertility is medium to high.

Hastings soils are suited to cultivated crops under both dryland and irrigated management. They are irrigated where sufficient water is available. They are also suited to grass, to tree and shrub plantings, and to all plants that provide habitat for wildlife.

Representative profile of Hastings silt loam, 1 to 3 percent slopes, in native grass, 800 feet west and 100 feet south of northeast corner of sec. 17, T. 2 N., R. 8 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A12—5 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium and coarse granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B1t—11 to 14 inches; grayish brown (10YR 5/2) light silty clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, friable; slightly acid; clear smooth boundary.

B2t—14 to 26 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse subangular blocky structure; hard, friable; neutral; clear smooth boundary.

B3t—26 to 33 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; hard, friable; mildy alkaline; clear smooth boundary.

C1—33 to 40 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; weak coarse prismatic structure; slightly hard, very friable; mildly alkaline; clear smooth boundary.

C2—40 to 60 inches; very pale brown (10YR 7/3) silt loam, light yellowish brown (10YR 6/4) moist; medium faint mottles, yellowish brown (10YR 5/6) moist; weak coarse prismatic structure; slightly hard, very friable; slight effervescence; mildly alkaline.

The A horizon is 8 to 12 inches thick. It is silt loam or silty clay loam. The B2t horizon is silty clay loam or light silty clay averaging between 35 and 42 percent clay. Depth to lime generally ranges from 36 to 50 inches, but is as much as 60 inches in places.

Hastings soils are near Crete and Geary soils. They have less clay in the B2t horizon than Crete soils. They have

Figure 7.—Profile of Hastings silt loam. The silty clay loam subsoil has subangular blocky structure.

more clay in the B2t horizon than Geary soils, which formed in more reddish material.

Hc—Hastings silt loam, 0 to 1 percent slopes. This soil is in the loess uplands. Areas range from 5 to 3,000 acres in size.

This soil has a profile similar to the one described as representative of the series, but the surface layer is slightly thicker. In some areas adjacent to the Republican and Little Blue River Valleys, the subsoil contains less clay. Included in mapping were small areas of Crete and Hall soils.

Lack of sufficient moisture is the chief limitation where this soil is dryfarmed. Organic-matter content is moderate. Runoff is medium.

This soil is one of the best in Nuckolls County for cultivated crops. Nearly all the acreage is cultivated. Wheat, grain sorghum, corn, and alfalfa are the main dryland crops. The soil is well suited to irrigation. Corn and grain sorghum are the chief irrigated crops. Capability units I–1 dryland, I–4 irrigated; Silty range site; windbreak suitability group 4.

HcB—Hastings silt loam, 1 to 3 percent slopes. This soil is on broad divides and ridges of the loess uplands. Areas range from 5 to 500 acres in size. This soil has the profile described as representative of the series. Included in mapping were small areas of Crete soils at slightly lower elevations.

The hazard of water erosion is moderate. Organic-matter content is moderate. Tilth is easily maintained. Runoff is medium.

Most of the acreage is cultivated. Wheat, grain sorghum, corn, and alfalfa are the chief dryland crops. Grain sorghum and corn are the main irrigated crops. Some land leveling is needed for the most efficient use of water in gravity irrigation systems. Capability units IIe–1 dryland, IIe–4 irrigated; Silty range site; windbreak suitability group 4.

HcC—Hastings silt loam, 3 to 6 percent slopes. This soil is on ridgetops and the short side slopes along drainageways in the loess uplands. Areas range from 10 to 300 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are slightly thinner. Included in mapping were small areas of eroded soils that are lighter colored than is typical and have a surface layer of silty clay loam. Also included were small areas of Holder silt loam.

The hazard of water erosion is severe. Unless the surface is adequately protected, rills and small gullies form during heavy rains. Organic-matter content is moderate. Runoff is medium.

Most of the acreage is cultivated. A small acreage is in native grasses. A few areas are irrigated. Grain sorghum, wheat, and alfalfa are the chief cultivated crops. Some corn is also grown. Capability units IIIe–1 dryland, IIIe–4 irrigated; Silty range site; windbreak suitability group 4.

HdC2—Hastings silty clay loam, 3 to 6 percent slopes, eroded. This soil is mainly on ridgetops and on side slopes along intermittent upland drainageways. Areas range from 10 to 40 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored and is silty clay loam. The subsoil is also thinner. Erosion has removed much of the original darkened surface layer. Tillage has mixed the rest of the original surface layer with the upper part of the subsoil. In places water erosion has been very severe and exposed the lighter colored lower part of the subsoil. Depth to lime ranges from 20 to 30 inches.

Included in mapping were small areas of eroded Holder silty clay loam. On 5 to 20 percent of this mapping unit, the surface layer is dark grayish brown silt loam 5 to 10 inches thick.

The hazard of water erosion is severe, especially in cultivated areas. The firm consistence of the surface layer makes workability somewhat difficult. Organic-matter content is low. This soil is not so fertile as the uneroded Hastings soil. Runoff is rapid.

Most of the acreage is cultivated. Grain sorghum and wheat are the main crops, but corn and alfalfa are also grown. A few areas are irrigated. Capability units IIIe–8 dryland, IIIe–3 irrigated; Silty range site; windbreak suitability group 4.

Hobbs Series

The Hobbs series consists of deep, nearly level, moderately well drained soils. These soils are on the narrow bottom land along intermittent drainageways and the low bottom land adjacent to perennial streams. They formed mainly in recent alluvium.

In a representative profile the surface layer is grayish brown silt loam about 7 inches thick. The underlying material is silt loam. The upper part is grayish brown and is stratified with thin layers of light brownish gray; the next part is gray; and the lower part to a depth of 60 inches is light brownish gray.

These soils absorb water easily and release it readily to plants. Permeability is moderate, and available water capacity is high. Natural fertility is medium to high.

Except in channeled areas, Hobbs soils are suited to cultivated crops under both dryland and irrigated management. They are also suited to grass and to tree and shrub plantings. Many areas furnish good habitat for wildlife. Some areas close to streams are in wooded pasture.

Representative profile of Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes, in a bluegrass pasture, 400 feet south and 100 feet east of northwest corner of sec. 32, T. 2 N., R. 7 W.

A1—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; hard, friable; neutral; abrupt smooth boundary.

C1—7 to 34 inches; stratified grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) silt loam, very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) moist; moderate fine and medium granular structure; hard, very friable; neutral; clear smooth boundary.

C2—34 to 44 inches; gray (10YR 5/1) silt loam, dark gray (10YR 4/1) moist; moderate fine and medium granular structure; slightly hard, very friable; neutral; clear smooth boundary.

C3—44 to 60 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; neutral.

The A horizon is 7 to 9 inches thick. Light and dark sediments are deposited as thin strata on the surface when these soils are flooded. Darkened buried soils below a depth of 10 inches are common.

Hobbs soils are near Cass and Hord soils. They have less sand between depths of 10 and 40 inches than Cass soils. They are more stratified than Hord soils and lack the B horizon typical of those soils. They are at lower elevations along streams than Hord soils.

HeB—Hobbs silt loam, channeled, 0 to 3 percent slopes. This soil is on low bottom land along narrow, intermittent and permanently flowing streams. Most areas are cut by the meandering channels and are bordered by short, steep side slopes. These areas are flooded several times each year, after each major rain, by overflow from the channels. They remain covered with water for periods of an hour to several days, depending on the intensity of the flood.

This soil is dark colored sediment that is dominantly silt loam. In some areas it is loam and very fine sandy loam. It is stratified with both light colored and dark colored alluvium.

Available water capacity is high, and permeability is moderate. Flooding is the principal hazard. Runoff is medium. Trash and debris are deposited by floodwater. Scouring by the moving water and damage to plants by silt deposition are also hazards.

This soil is not suitable for cultivation because the flood hazard is too severe. Most of the acreage is in range or pasture. Many trees grow adjacent to channels in the more stable areas. Level areas and the short side slopes have a fair grass cover. Capability unit VIw–7 dryland; Silty Overflow range site; windbreak suitability group 10.

Hf—Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes. This soil formed in silty alluvium on the low bottom land along drainageways. Areas are generally long and narrow and range from 5 to 120 acres in size. This soil has the profile described as representative of the series, but in a few small areas it has thin strata of fine sandy loam. Included in mapping were small areas of Cass silt loam and Hord silt loam.

The surface layer is friable and easily tilled. Occasional flooding following heavy rains is the main hazard. Flooding seldom causes a total crop loss, but at times it delays tillage or necessitates reseeding of newly planted crops. Organic-matter content is moderate. Runoff is slow.

Most of the acreage is cultivated. Grain sorghum, corn, and alfalfa are the most common crops. The hazard of flooding in spring limits the use of this soil for wheat. The soil is suited to irrigation, but the hazard of flooding and the narrow soil areas limit the acreage that can be efficiently irrigated. Grain sorghum and corn are the chief irrigated crops. Small areas adjacent to the major streams or drainage channels commonly have a dense cover of trees and tame grasses. These areas are used for limited grazing. Capability units IIw–3 dryland, IIw–6 irrigated; Silty Overflow range site; windbreak suitability group 1.

Holder Series

The Holder series consists of deep, very gently sloping to strongly sloping, well drained soils. These soils formed in loess on uplands.

In a representative profile (fig. 8) the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is about 21 inches thick. The upper part is dark grayish brown, very friable heavy silt loam; the

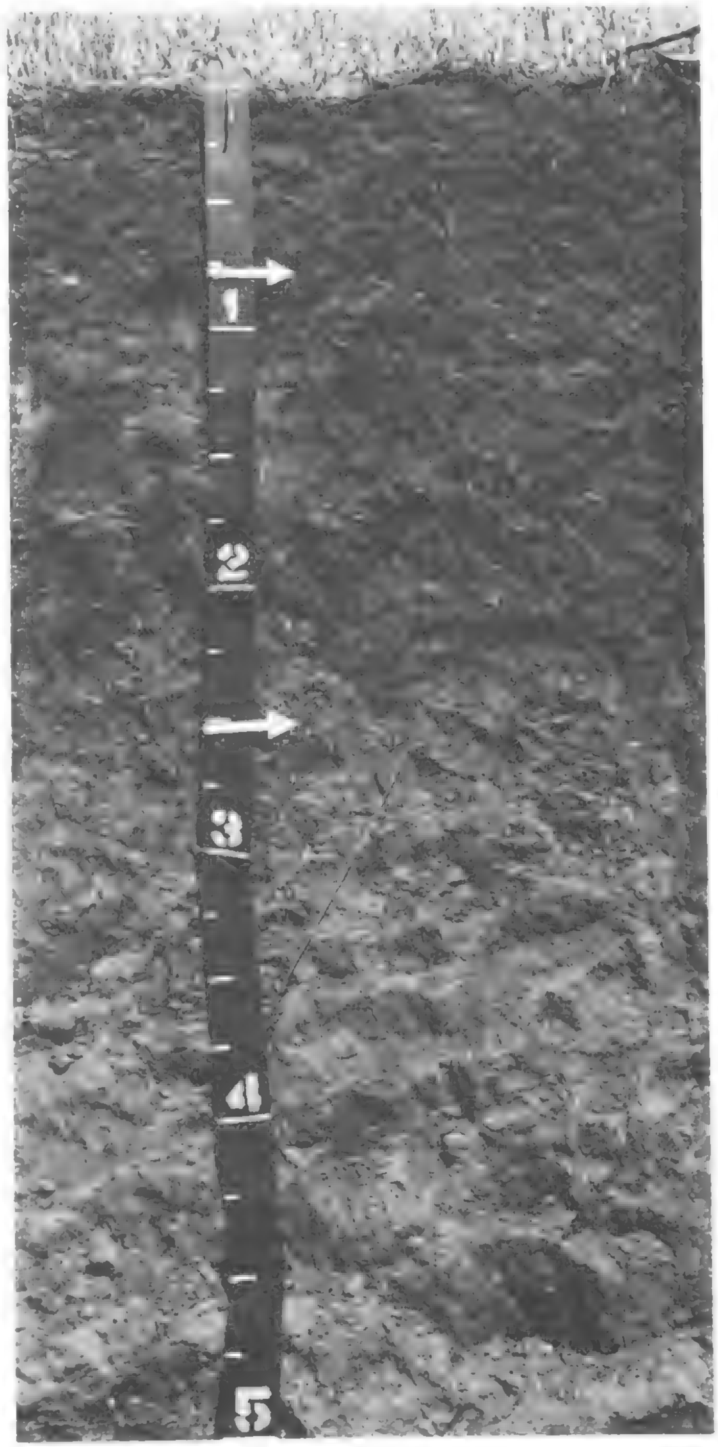


Figure 8.—**Profile of Holder silt loam. This deep soil has a thick surface layer and a well defined subsoil.**

next part is grayish brown, friable light silty clay loam; and the lower part is pale brown, friable heavy silt loam. The underlying material is very pale brown silt loam to a depth of 60 inches. Lime is at a depth of 39 inches.

These soils absorb moisture readily and release it readily to plants. Permeability is moderate, and available water capacity is high. Natural fertility is medium or high.

Holder soils are suited to cultivated crops under both dryland and irrigated management. The less sloping areas are well suited to irrigation, but sufficient water is not available in all parts of the county. The soils are suited to grass, to tree and shrub plantings, and to all plants that furnish habitat for wildlife.

Representative profile of Holder silt loam, 3 to 6 percent slopes, in native grass, 2,380 feet west and 150 feet north of southeast corner of sec. 33, T. 1 N., R. 8 W.

A—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium and coarse granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B1—10 to 13 inches; dark grayish brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B2t—13 to 25 inches; grayish brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse subangular blocky structure; hard, friable; neutral; clear smooth boundary.

B3—25 to 31 inches; pale brown (10YR 6/3) heavy silt loam, brown (10YR 5/3) moist; weak moderate and coarse subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

C1—31 to 39 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; few fine distinct mottles, yellowish brown (10YR 5/6) moist; weak coarse prismatic structure; slightly hard, very friable; neutral; gradual smooth boundary.

C2—39 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; few fine distinct mottles, yellowish brown (10YR 5/6) moist; lime is prominent on cleavage planes; weak coarse prismatic structure; slightly hard, very friable; violent effervescence; mildly alkaline.

The A horizon is 7 to 14 inches thick. It is silt loam or silty clay loam. The B2t horizon is light silty clay loam averaging between 28 and 35 percent clay. Some thin horizons are 35 to 38 percent clay. Depth to lime is commonly more than 42 inches, but ranges from 36 to 60 inches.

Holder soils are near Hastings and Geary soils. They have less clay in the B2t horizon than Hastings soils. Geary soils formed in more reddish material.

HgB—Holder silt loam, 1 to 3 percent slopes. This soil is on gentle divides of the loess upland. Areas range from 10 to 60 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is slightly thicker. Included in mapping were small areas of Hastings silt loam.

This soil takes in moisture readily and is easy to keep in good tilth. The hazard of water erosion is moderate. Natural fertility is high, and organic-matter content is moderate. Runoff is medium.

Most of the acreage is cultivated. Some of the smaller areas are in native grass. Grain sorghum, wheat, and alfalfa are the chief dryfarmed crops. This soil is well suited to irrigation, but underground water is not available in most areas. Corn and grain sorghum are the main irrigated crops. Capability units IIe-1 dryland, IIe-4 irrigated; Silty range site; windbreak suitability group 4.

HgC—Holder silt loam, 3 to 6 percent slopes. This soil is on divides between intermittent drainageways and on ridgetops of the loess uplands. Areas range from 10 to 100 acres in size. This soil has the profile described as representative of the series. Included in mapping were a few areas of the eroded Holder silty clay loam and Hastings silt loam.

The hazard of water erosion is severe. Natural fertility is high in the uneroded areas and medium where the surface layer has been thinned by erosion. Organic-matter content is moderate. Runoff is medium.

Nearly all the acreage is cultivated, mainly to dry-farmed grain sorghum, wheat, and alfalfa. Corn and grain sorghum are the main irrigated crops. The rest of the acreage is in native grass and is used for grazing. Capability units IIIe-1 dryland, IIIe-4 irrigated; Silty range site; windbreak suitability group 4.

HgD—Holder silt loam, 6 to 11 percent slopes. This soil is on divides between intermittent drainageways of the loess uplands. Areas range from 70 to 160 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner and depth to lime is less. Included in mapping were small areas of Geary silt loam and Hastings silt loam.

The hazard of water erosion is severe, particularly in cultivated areas. Good management is needed to protect the soils if tilled crops are grown. Organic-matter content is moderate. Runoff is medium.

Nearly all the acreage is in native grass and is used for range. This soil is suitable for cultivation. Wheat, grain sorghum, and alfalfa are the chief crops. In the few irrigated areas, grain sorghum and corn are the main crops. Capability units IVe-1 dryland, IVe-4 irrigated; Silty range site; windbreak suitability group 4.

HhC2—Holder silty clay loam, 3 to 6 percent slopes, eroded. This soil is on ridgetops and hillsides between intermittent drainageways of the loess uplands. Areas are long and narrow, ranging from 10 to 60 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored and is silty clay loam. Also, depth to lime is less. Included in mapping were small areas of an eroded Hastings silty clay loam. On 5 to 20 percent of this mapping unit, the surface layer is grayish brown silt loam 7 to 12 inches thick.

The hazard of water erosion is severe. Water erosion has removed most of the original darkened surface layer, and tillage has mixed the rest with the upper part of the subsoil. The present surface layer is not so friable as that in uneroded areas. Fertility in this eroded soil is medium or low. Workability is only fair because the silty clay loam surface layer is low in content of organic matter. Runoff is medium.

Most of the acreage is cultivated. This soil is suited to most of the dryland crops commonly grown in the county. A limited acreage is irrigated. A few areas have been seeded to native grasses. Capability units IIIe-8 dryland, IIIe-3 irrigated; Silty range site; windbreak suitability group 4.

HhD2—Holder silty clay loam, 6 to 11 percent slopes, eroded. This soil is on ridgetops and hillsides between intermittent drainageways of the loess uplands. Areas range from 10 to 100 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored and is silty clay loam. Also, depth to lime is less. On 5 to 20 percent of this unit, the surface layer is dark grayish brown silt loam 7 to 12 inches thick. Included in mapping were small areas of an eroded Geary silty clay loam. Also included were small severely eroded areas where the very pale brown underlying material is exposed at the surface.

The hazard of water erosion is very severe where this soil is cultivated. Nearly all the darkened surface layer has been removed by erosion, and the rest has been mixed with the upper part of the subsoil. Small gullies are common after heavy rains. Workability is only fair because the silty clay loam surface layer is low in content of organic matter. Runoff is medium.

Most of the acreage is cultivated. A few areas have been seeded to native grasses. Wheat, grain sorghum, and alfalfa are the main crops. Only a small acreage is irrigated. It is mainly in alfalfa. Capability units IVe–8 dryland, IVe–3 irrigated; Silty range site; windbreak suitability group 4.

Hord Series

The Hord series consists of deep, nearly level to gently sloping, well drained soils. These soils are on bottom lands and stream terraces of major stream valleys. They formed in silty alluvium.

In a representative profile the surface layer is silt loam about 14 inches thick. The upper part is gray, and the lower part is grayish brown. The subsoil is friable silt loam about 32 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The underlying material is pale brown silt loam to a depth of 60 inches.

These soils absorb water easily and release it readily to plants. Permeability is moderate, and available water capacity is high.

Hord soils are among the best soils for farming in the county. They are suited to cultivated crops under both dryland and irrigated management. They are extensively irrigated where sufficient water is available. They are suited to grass and to tree and shrub plantings. Many areas furnish habitat for wildlife.

Representative profile of Hord silt loam, 0 to 1 percent slopes, in a cultivated field, 800 feet north and 100 feet east of southwest corner of sec. 28, T. 1 N., R. 6 W.

Ap—0 to 6 inches; gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A12—6 to 14 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B21—14 to 20 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

B22—20 to 38 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

B3—38 to 46 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; neutral clear smooth boundary.

C—46 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; slightly hard, friable; slight effervescence; mildly alkaline.

The A horizon ranges from 12 to 24 inches in thickness. Buried soils occur in some areas. The A horizon is dominantly silt loam, but in some small areas it is loam. Content of clay in the B2 horizon ranges from 20 to 35 percent. In some areas stratified layers of dark and light colored sediment are in the C horizon. Lime generally occurs between depths of 35 and 55 inches.

Hord soils are near Hobbs and Hall soils. In contrast with Hobbs soils, they have a B horizon and are less stratified. They have less clay in the B2 horizon than Hall soils.

Hr—Hord silt loam, 0 to 1 percent slopes. This soil formed in silty alluvium on bottom land and stream terraces. Areas range from 10 to 2,000 acres in size. This soil has the profile described as representative of the series. Included in mapping were a few small areas of Hall soils. Also included were small areas on breaks between the stream terraces and the bottom land where the surface layer is fine sandy loam.

This soil is easily tilled. Lack of sufficient moisture is the main limitation in dryfarmed areas. Organic-matter content is moderate. Runoff is slow.

Most of the acreage is cultivated. This soil is suited to all crops commonly grown in the county. Alfalfa, corn, and grain sorghum are the chief crops. Most areas are irrigated; corn and grain sorghum are the main irrigated crops. Capability units I–1 dryland, I–6 irrigated; Silty Lowland range site; windbreak suitability group 1.

HrB—Hord silt loam, 1 to 3 percent slopes. This soil is on side slopes of shallow, intermittent drainageways, on foot slopes of stream terraces, and on low ridges in stream valleys. Areas range from 5 to 60 acres in size. This soil has a profile similar to the one described as representative of the series, but in many places colluvium and alluvium have thickened the surface layer. Included in mapping were a few small areas where the subsoil has more clay than is typical and the upper part of the subsoil is not so dark.

The hazard of water erosion is moderate, especially in cultivated areas. Organic-matter content is moderate. The soil is easily tilled. Runoff is medium.

Most of the acreage is cultivated. This soil is suited to all crops commonly grown in the county. Alfalfa, corn, grain sorghum, and wheat are the chief crops. Corn and grain sorghum are the main irrigated crops. Capability units IIe–1 dryland, IIe–6 irrigated; Silty Lowland range site; windbreak suitability group 1.

HrC—Hord silt loam, 3 to 6 percent slopes. This soil is along intermittent drainageways or on breaks between levels on stream terraces. Areas are long and narrow and range from 5 to 40 acres in size. This soil has a profile similar to the one described as representative of the series, but in most places the dark surface layer is thinner. Included in mapping were a few small areas where the subsoil is light silty clay loam.

The hazard of water erosion is severe, especially in cultivated areas. Organic-matter content is moderate. The soil is easily tilled. Runoff is medium.

Nearly all the acreage is cultivated. This soil is suited to irrigation, but is not extensively irrigated because of the erosion hazard in these gently sloping areas. Corn, grain sorghum, alfalfa, and wheat are the main crops. Corn and grain sorghum are the main irrigated crops. Capability units IIIe-1 dryland, IIIe-6 irrigated; Silty range site; windbreak suitability group 4.

Inavale Series

The Inavale series consists of deep, nearly level, somewhat excessively drained soils. These soils are on bottom land in the Republican River Valley and along the largest tributaries of the river. They formed in recent sandy and loamy alluvium. Low lying areas are subject to occasional flooding.

In a representative profile the surface layer is grayish brown loamy fine sand about 7 inches thick. The underlying material is very pale brown loamy sand to a depth of 60 inches.

These soils are droughty because of the coarse underlying material. Permeability is rapid, and available water capacity is low. Natural fertility is low.

Inavale soils can be used for certain cultivated crops, but are used mostly for grassland. They are also suited to trees and shrubs and to all plants that provide habitat for wildlife.

Representative profile of Inavale loamy fine sand, 0 to 2 percent slopes, in bromegrass, 600 feet north and 300 feet west of southeast corner of sec. 33, T. 1 N., R. 6 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; mildly alkaline; clear smooth boundary.

C—7 to 60 inches; very pale brown (10YR 7/3) loamy sand, pale brown (10YR 6/3) moist; single grained; loose; thin stratified layers of sandy loam and loam; very friable; mildly alkaline.

The A horizon is loamy fine sand or fine sandy loam. It is 4 to 10 inches thick. In some areas the AC horizon is light brownish gray or pale brown. In places the C horizon is stratified with thin layers that range from loam to fine sand. Soils in lower lying areas have yellowish brown (10YR 5/6) mottles below 40 inches.

Inavale soils are near Wann, Munjor, and McCook soils. They contain more sand in the C horizon than those soils and are more excessively drained.

Ig—Inavale loamy fine sand, 0 to 2 percent slopes. This gently undulating soil is on bottom land. Areas are irregular in shape and range from 10 to 40 acres in size. This soil has the profile described as representative of the series. Included in mapping were a few small areas where the underlying material is coarse sand and gravel at a depth of 10 to 18 inches. Also included were a few small areas of Munjor soils.

The hazard of soil blowing is severe in cultivated areas. The soil tends to be difficult to cultivate because of its loose consistence. Runoff is slow because most of the rainfall is absorbed as rapidly as it falls. Drought is a hazard.

Most of the acreage has been cultivated. Most areas have been seeded to either native or tame grasses and used for grazing. The rest is cultivated. Alfalfa and grain sorghum are the main dryland crops. This soil can be sprinkler irrigated. Capability units IVe-5 dryland, IIIe-11 irrigated; Sandy Lowland range site; windbreak suitability group 3.

In—Inavale fine sandy loam, 0 to 2 percent slopes. This soil is on bottom land. Areas are generally long and range from 5 to 30 acres in size. This soil has a profile similar to the one described as representative of the Inavale series, but the surface layer is fine sandy loam. Included in mapping were small areas where the surface layer is loamy sand or loam. Also included were small areas of Munjor soils.

This soil is easily worked. The hazard of soil blowing is severe in cultivated areas. The coarse texture of the underlying material limits the available water capacity. The soil tends to be droughty if it is dryfarmed. Runoff is slow, and some low lying areas are subject to occasional flooding.

Most of the acreage is cultivated. The rest is in grass and is used for grazing. Grain sorghum and alfalfa are the main crops. A few areas are used for wheat. This soil can be sprinkler irrigated. Capability units IIIe-3 dryland, IIIe-11 irrigated; Sandy Lowland range site; windbreak suitability group 3.

Jansen Series

The Jansen series consists of gently sloping to steep, well drained soils on uplands. These soils formed mainly in silty and loamy material that is moderately deep over mixed sand and gravel.

In a representative profile the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is about 14 inches thick. The upper 3 inches is friable, grayish brown silt loam, and the lower 11 inches in friable, grayish brown clay loam. The underlying material is very pale brown mixed sand and gravel.

These soils are droughty and erode easily. Root penetration is severely restricted by the underlying sand and gravel. Permeability is moderate in the upper part and very rapid in the underlying sand and gravel. Available water capacity is moderate. Natural fertility is medium to low.

Jansen soils are suited to cultivated crops where the slope is no more than 11 percent. They are also suited to grass, to tree and shrub plantings, and to all plants that provide habitat for wildlife.

The Jansen soils in Nuckolls County were mapped only with Geary soils.

Representative profile of Jansen silt loam in an area of Geary and Jansen silt loams, 3 to 6 percent slopes, in native vegetation, 1,580 feet south and 500 feet west of northeast corner of sec. 9, T. 1 N., R. 8 W.

A—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, very friable; medium acid; abrupt smooth boundary.

B1—10 to 13 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

B2t—13 to 24 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

IIC—24 to 60 inches; very pale brown (10YR 7/3) mixed sand and gravel, pale brown (10YR 6/3) moist; single grained; loose; slightly acid.

The A horizon is dominantly silt loam, but is loam in places. The A and B horizons are 1 to 5 percent coarse sand and gravel. The B2t horizon is dominantly clay loam, but in small areas is loam, silt loam, and sandy clay loam. Scattered pebbles occur throughout the A and B horizons in some areas. Depth to the underlying sand and gravel averages about 24 inches, but ranges from 20 to 40 inches.

Jansen soils are near Hastings, Holder, Geary, and Meadin soils. They are not so deep as Hastings and Holder soils, which formed in thick deposits of loess. Their B2t horizon has less clay than that of Hastings soils. They have more sand in the B horizon than Geary soils and, unlike those soils, have sand and gravel within a depth of 40 inches. They are deeper over sand and gravel than Meadin soils, which have sand and gravel within a depth of 20 inches.

Kipson Series

The Kipson series consists of shallow, strongly sloping to steep, somewhat excessively drained soils on uplands. These soils formed in material weathered from interbedded silty shale and soft limestone. A thin layer of loess overlies the weathered bedrock in most places.

In a representative profile (fig. 9) the surface layer is grayish brown silt loam about 7 inches thick. Beneath this is a transitional layer of grayish brown silt loam about 9 inches thick. The underlying bedrock is silty shale.

Permeability is moderate above the bedrock. Available water capacity is low. Internal drainage is restricted by the underlying bedrock. Natural fertility is medium.

Kipson soils are suited to grass. They are too steep and too shallow for the commonly grown cultivated crops. They are not suited to tree and shrub plantings. Many areas furnish good habitat for wildlife.

Representative profile of Kipson silt loam, 6 to 30 percent slopes, in native range, 2,100 feet south and 800 feet west of the northeast corner of sec. 29, T. 1 N., R. 9 W.

A1—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; solt, very friable; slight effervescence; mildly alkaline; clear smooth boundary.

AC—7 to 16 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; soft, very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1—16 to 18 inches; light brownish gray (10YR 6/2) heavy silt loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; soft, friable; common small fragments of weathered silty shale; violent effervescence; moderately alkaline; clear gradual boundary.

C2—18 to 36 inches; very pale brown (10YR 7/3) fractured silty shale, brownish yellow (10YR 6/6) moist; massive; hard; violent effervescence; moderately alkaline.

The A horizon is dominantly silt loam, but in some areas is silty clay loam. Depth to the underlying bedrock ranges from 7 to 20 inches. These soils are typically calcareous throughout, but in some areas lack lime in the upper 1 inch to 3 inches.

Kipson soils are near Holder and Geary soils. They are shallow over fractured, calcareous silty shale, whereas Holder and Geary soils are deep and formed in loess.

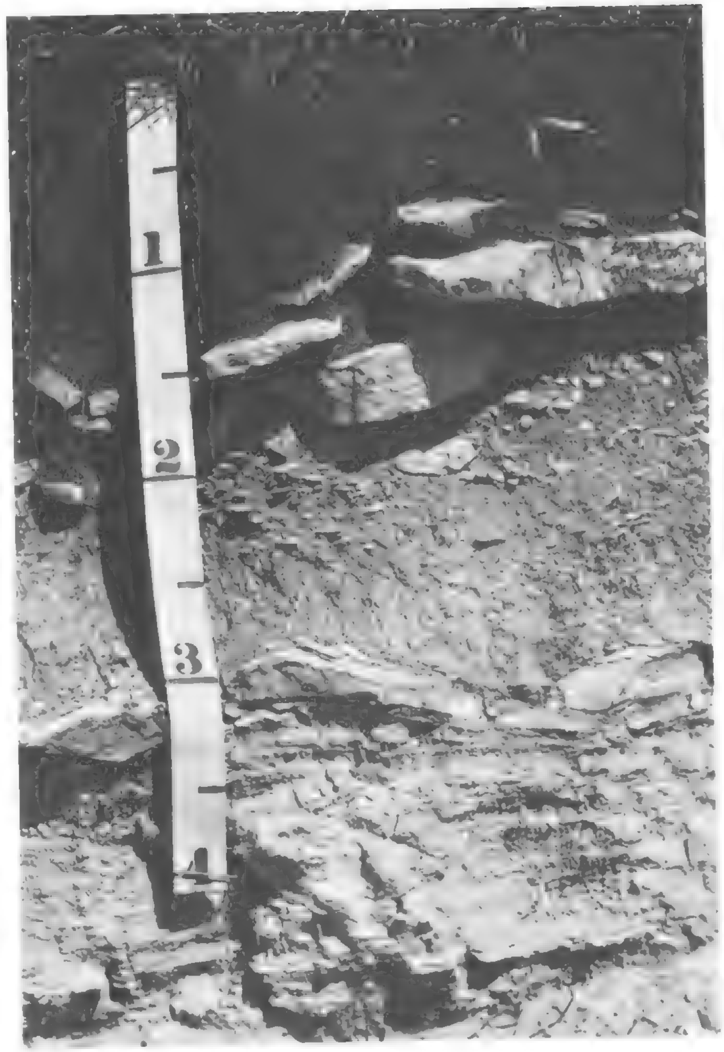


Figure 9.—Profile of Kipson silt loam, a shallow soil formed in material weathered from interbedded shale and limestone.

KsF—Kipson silt loam, 6 to 30 percent slopes. This soil is on uplands, along intermittent drainageways that have eroded into the landscape. Areas are irregular in shape and range from 5 to 25 acres in size.

Included with this soil in mapping were areas of soils less than 7 inches deep over the weathered underlying silty shale. In some small areas the soil is shallow over soft limestone. Some mapped areas are 5 to 15 percent outcrops of shale and limestone. Included soils make up as much as 30 percent of some mapped areas.

Lack of sufficient soil depth for roots and storage of available water is the chief limitation. This soil absorbs water readily until saturated. Outcrops of bedrock are more common on the steeper parts of this unit than on the strongly sloping parts. Organic-matter content is moderately low. Runoff is rapid.

Nearly all the acreage is in native grasses. This soil is used mostly for range. Some of the less steep areas are mowed for hay. Capability unit VIs–4 dryland; Shallow Limy range site; windbreak suitability group 10.

Marsh

Ma—Marsh consists of wet, periodically flooded, upland depressions and areas of wet bottom land in the Republican River Valley where the water table is at or near the surface. It is waterlogged during most of the growing season, commonly under 6 to 24 inches of water. The plant cover is mainly bulrushes, spikerushes, arrowheads, cattails, and other marsh type vegetation. From 25 to 75 percent of the acreage is covered with vegetation. The rest is covered with open water except during extended dry periods when the water evaporates or is below the ground surface. Willow trees are common on bottom land.

The soil material is silty clay or clay in the upland depressions and loam, silt loam, or silty clay loam on bottom land. In the upland depressions Marsh is associated with Scott and Fillmore soils, but is more poorly drained than those soils. On bottom land, Marsh is associated with Wann soils and with Saline-alkali land, but has a higher water table.

Marsh is suited to the production and protection of wetland wildlife. It is too wet for cultivated crops or trees. Capability unit VIIIw–7; not assigned to a range site; windbreak suitability group 10.

McCook Series

The McCook series consists of deep, nearly level, moderately well drained soils. These soils are mainly on bottom land in the Republican River Valley. They formed in silty and loamy alluvium. Depth to the fluctuating water table ranges from 4 feet in spring to 6 feet in fall.

In a representative profile the surface layer is silt loam about 13 inches thick. The upper part is gray, and the lower part is grayish brown. The underlying material is very pale brown very fine sandy loam to a depth of 60 inches. Free carbonates are throughout the profile.

These soils absorb moisture easily and release it readily to plants. Permeability is moderate, and available water capacity is high. Natural fertility is high.

McCook soils are well suited to cultivated crops, both dryland and irrigated. They are also suited to grass and to trees and shrubs. Many areas provide habitat for wildlife.

Representative profile of McCook silt loam, 0 to 1 percent slopes, in irrigated cropland, 1,800 feet north and 50 feet east of southwest corner of sec. 36, T. 1 N., R. 7 W.

AP—0 to 7 inches; gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; soft, friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

A12—7 to 13 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; strong effervescence; moderately alkaline; clear smooth boundary.

C—13 to 60 inches; very pale brown (10YR 7/3) very fine sandy loam, grayish brown (2.5Y 5/2) moist; few fine distinct mottles, yellowish brown (10YR 5/6) moist; weak medium and coarse subangular blocky structure; loose, very friable; thin stratified layers of sandy loam material; strong effervescence; moderately alkaline.

The A horizon is silt loam or fine sandy loam 12 to 19 inches thick. The C horizon contains thin strata of soil material ranging from loamy fine sand to clay loam.

McCook soils are near Wann, Munjor, and Cozad soils. They are better drained than Wann soils and have more silt in the C horizon than Wann and Munjor soils. They have less silt in the C horizon than Cozad soils and, unlike those soils, lack a B horizon.

Mb—McCook fine sandy loam, 0 to 2 percent slopes. This soil is on bottom land. It formed in loamy alluvium. Areas range from 10 to 100 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is fine sandy loam. Included in mapping were small areas of Munjor and Inavale soils.

Soil blowing is a hazard unless the surface is protected. The surface layer is friable and is easily tilled. Organic-matter content is moderate. Runoff is slow. The lower lying areas are occasionally flooded following rains. Phosphate fertilizer is generally beneficial to legumes. Much of the soil phosphate is not readily available to plants because of excess lime.

Nearly all the acreage is cultivated. This soil is well suited to irrigation. A few irregularly shaped areas adjacent to river channels are in mixed grass and trees. Corn, grain sorghum, and alfalfa are the main dryland crops. Corn and grain sorghum are the main irrigated crops. Capability units IIe–3 dryland, IIe–5 irrigated; Silty Lowland range site; windbreak suitability group 3.

Mc—McCook silt loam, 0 to 1 percent slopes. This soil is on bottom land. Areas are long and range in size from 30 to 400 acres. This soil has the profile described as representative of the series. In a few areas, however, the upper part of the underlying material is loam or silty clay loam. Included in mapping were small areas of Munjor and Wann soils.

Soil blowing is a hazard unless the surface is adequately protected. The surface layer is friable and is easily tilled. Organic-matter content is moderate. Runoff is slow. Some of the lower lying areas are flooded for short periods after rains. The excess lime in this soil makes much of the soil phosphate unavailable to plants, particularly legumes.

Most of the acreage is cultivated. This soil is suited to irrigation. The chief dryland crops are corn, alfalfa, and grain sorghum. A limited acreage is in wheat. The main irrigated crops are corn and grain sorghum. Capability units I–1 dryland, I–6 irrigated; Silty Lowland range site; windbreak suitability group 1.

Meadin Series

The Meadin series consists of excessively drained, strongly sloping to steep soils that are shallow over mixed sand and gravel. These soils are along intermittent drainageways in the uplands.

In a representative profile (fig. 10) the surface layer is dark grayish brown loam about 9 inches thick. Be-

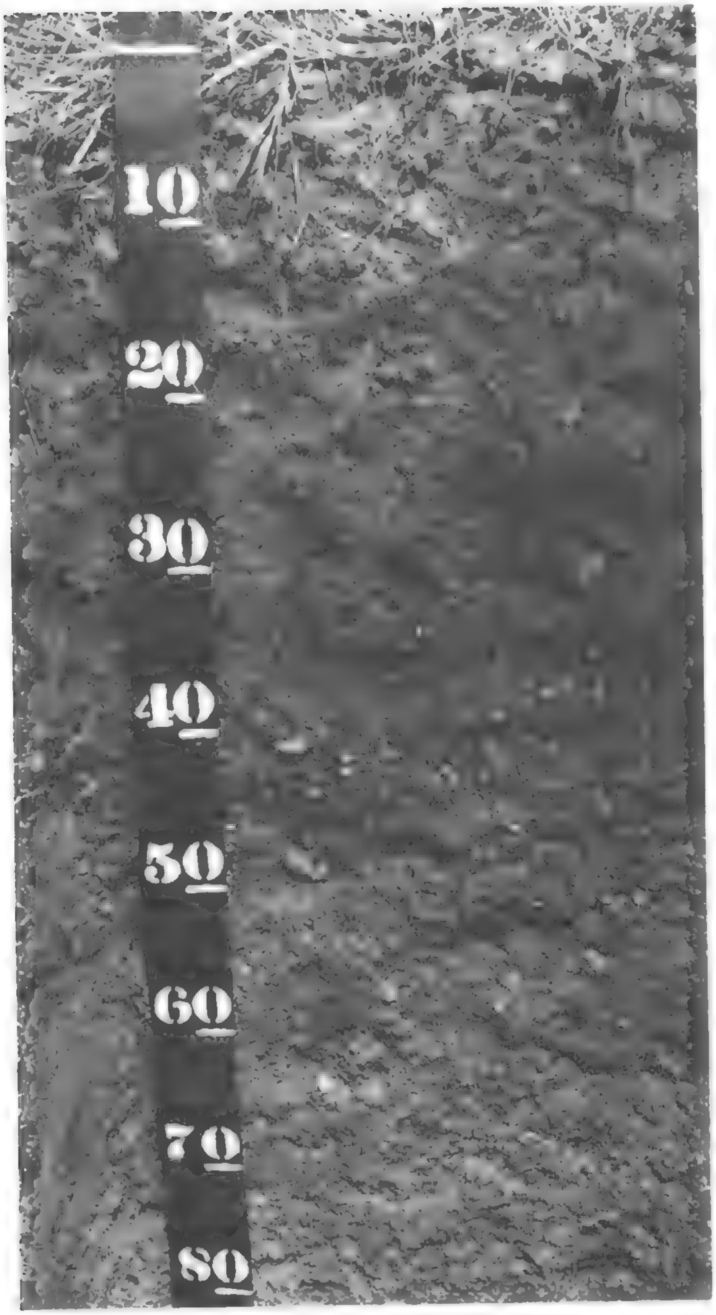


Figure 10.—Profile of Meadin loam, a shallow soil over mixed sand and gravel. Depth is indicated in centimeters.

neath this is a transition layer of dark grayish brown gravelly sandy loam about 6 inches thick. The underlying material is mixed coarse sand and gravel. It is brown in the upper 5 inches and very pale brown to a depth of 60 inches.

Permeability is rapid in the transition layer and very rapid in the mixed sand and gravel. Available water capacity is low. Natural fertility is low. These soils are droughty.

Meadin soils are suited to native grass and are used almost entirely for range. They are unsuited to the commonly grown cultivated crops, to trees, and to most shrubs. The soils provide cover and produce a limited supply of food for certain species of wildlife.

Representative profile of Meadin loam, 6 to 30 percent slopes, in native grass, 1,320 feet west and 600 feet north of southeast corner of sec. 31, T. 2 N., R. 8 W.

A1—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

AC—9 to 15 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; slightly acid; clear smooth boundary.

IIC1—15 to 20 inches; brown (10YR 5/3) mixed sand and gravel, dark brown (10YR 4/3) moist; single grained; loose; slightly acid; clear smooth boundary.

IIC2—20 to 60 inches; very pale brown (10YR 7/4) mixed sand and gravel, light yellowish brown (10YR 6/4) moist; single grained; loose; slightly acid.

The A horizon is dominantly loam, but in some areas is silt loam. Depth to the IIC horizon of sand and gravel ranges from 8 inches to 20 inches, depending on the topography, the degree of erosion, and the pattern of deposition of the loamy material over the sand and gravel. Few to many scattered coarse pebbles are commonly on the surface and throughout the profile.

Meadin soils are near Jansen and Geary soils. They are shallower over sand and gravel than Jansen soils and lack the B horizon typical of those soils. They are shallower over sand and gravel than Geary soils, which are deep and formed in silty material of the Loveland Formation.

MdF—Meadin loam, 6 to 30 percent slopes. This soil is along intermittent drainageways in the uplands. A few areas were formerly cultivated. These areas are severely eroded. The original darkened surface layer has been washed away, and the present surface layer is gravelly sandy loam.

Included Geary and Jansen soils make up as much as 20 percent of some mapped areas. Also included were a few small areas of Hastings and Holder soils. In a few areas the surface is gravelly.

Lack of sufficient available moisture is the chief limitation. The shallowness over coarse sand and gravel not only limits storage of moisture, making the soil droughty, but also limits the root zone. Organic-matter content is low. Runoff is medium to rapid, depending on the slope.

This soil is not suited to cultivation because of the slope and the low available water capacity. Most of the acreage is in native grass and is used as range. Formerly cultivated areas have been reseeded to grass or allowed to revegetate. Capability unit VIs-4 dryland; Shallow to Gravel range site; windbreak suitability group 10.

Munjor Series

The Munjor series consists of deep, nearly level, moderately well drained soils. These soils are on bottom land in the Republican River Valley. They formed in recent alluvium. They are occasionally flooded. Depth to the water table ranges from 4 feet during high streamflow to 8 feet in midsummer.

In a representative profile the surface layer is about 15 inches thick. It is grayish brown loam in the upper part and light brownish gray very fine sandy loam in the lower part. Beneath this is a transition layer of light brownish gray sandy loam. The upper part of the underlying material is light gray loamy fine sand, and the lower part is light brownish gray very fine sandy loam to a depth of 60 inches. The soil is limy below a depth of 5 inches.

Permeability is moderately rapid, and available water capacity is moderate. Natural fertility is medium to low.

Munjor soils are suited to cultivated crops under both dryland and irrigated management. They are also suited to grass and to tree and shrub plantings. These soils provide good habitat for wildlife.

Representative profile of Munjor loam, in an area of Munjor soils, 0 to 2 percent slopes, in cultivated cropland, 3,700 feet south and 200 feet east of the northwest corner of sec. 30, T. 1 N., R. 7 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable; mildly alkaline; abrupt smooth boundary.

A12—5 to 15 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; weak fine and medium granular structure; slightly hard, very friable; slight effervescence; moderately alkaline; clear smooth boundary.

AC—15 to 24 inches; light brownish gray (10YR 6/2) sandy loam, dark gray (10YR 4/1) moist; weak fine and medium subangular blocky structure; loose, very friable; slight effervescence; moderately alkaline; clear smooth boundary.

C1—24 to 34 inches; light gray (10YR 7/2) loamy fine sand, light brownish gray (10YR 6/2) moist; single grained; loose; mildly alkaline; abrupt smooth boundary.

C2—34 to 60 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; strong effervescence; strongly alkaline.

The A horizon is 8 to 15 inches thick. It is silt loam, loam, or fine sandy loam. It is commonly grayish brown, light brownish gray, or gray. The AC and C horizons are generally sandy loam or loamy fine sand, but in some areas these horizons are thin, stratified layers of finer textured material. Depth to free carbonates is less than 10 inches.

Munjor soils are near Wann, Inavale, and McCook soils. They lack the mottles in the C horizon typical of Wann soils and are better drained than those soils. They have less sand in the C horizon than Inavale soils. They have more sand and less silt in the C horizon than McCook soils.

Mu—Munjor soils, 0 to 2 percent slopes. These soils formed in alluvium on bottom land. The surface layer is dominantly silt loam, but in some areas is loam and fine sandy loam. Most areas have a low ridge and channel type topography that parallels the main stream channels. Areas range from 20 to 200 acres in size. Included in mapping were small areas of Inavale soils at the higher elevations and Wann soils at slightly lower elevations.

The hazard of soil blowing is moderate unless the surface is protected. These soils are friable and are easily tilled. Organic-matter content is moderate. Runoff is slow. During extended dry periods and late in summer, the lack of adequate moisture is the main limitation in dryfarmed fields. Available phosphate is low where the surface layer has an excess of lime. Flooding from the mainstream channels can occur after heavy rains upstream.

Most of the acreage is cultivated. A small acreage is irrigated. A few areas are in trees and native grass. Corn, grain sorghum, and alfalfa are the chief dryland crops. Corn and grain sorghum are the main irrigated crops. Capability units IIIw–3 dryland, IIIw–8 irrigated; Sandy Lowland range site; windbreak suitability group 3.

Saline-Alkali Land

Sa—Saline-alkali land is on botton land in the Republican River Valley, adjacent to and directly below breaks of the stream terraces. Slopes are 0 to 1 percent. This land consists of stream sediment that is kept permanently wet by seepage. The moderately high water table and, at times, surface flooding contribute to the wetness. The sediments are stratified, and the texture ranges from sandy loam to clay loam. The coarser textured sediment is the lighter colored. Included in mapping were small areas of Marsh.

Saline-alkali land is poorly drained, is strongly mottled, is generally calcareous, and is affected by excess soluble salts and high alkali. The concentration of both salts and alkali varies greatly within short distances. Runoff is slow or ponded. Areas are too wet to work, and the saline-alkali condition is too strong for most cultivated crops. Natural fertility is low and is not well balanced. Organic-matter content is low.

Saline-alkali land is used mainly for limited grazing. It is not suited to the commonly grown cultivated crops. A few areas are cultivated, but with very limited success. The native vegetation is salt-tolerant grasses, western wheatgrass, bluegrass, annual weeds, and willow trees, cattails, and rushes. The more thickly vegetated areas provide habitat for some species of wildlife. Capability unit VIs–1 dryland; Saline Subirrigated range site; windbreak suitability group 10.

Sandy Alluvial Land

Sb—Sandy alluvial land is water-deposited material on sandbars and sand flats within and adjacent to channels of the Little Blue River and the Republican River and in old channels of the rivers where water no longer flows. It is marked with low mounds and shallow channels formed by moving floodwater. The size and shape of the areas are irregular and change with the more rapid streamflow during flood stages and when the water level is high. Trash and debris are commonly deposited by the floodwater. The adjacent flood plains are 1 to 4 feet above normal streamflow. Slopes are 0 to 2 percent.

Sandy alluvial land is stratified material, consisting mainly of sandy loam, loamy sand, and in places sand mixed with gravel. The alluvium is recent, but has been in place long enough for plants to become established. Permeability is rapid or very rapid. Runoff is medium.

Sandy alluvial land supports annual weeds, brush, and willows, but the areas are continually being scoured and channeled by floodwater. For this reason, the plant

cover is unstable. Dense stands of willow, cottonwood, annual weeds, and common reedgrass grow in the old abandoned stream channels where the soil material is more stable.

Sandy alluvial land is not well suited to grazing, but is commonly grazed by livestock. The more densely vegetated areas provide good cover for wildlife. Capability unit VIIw–7 dryland; not assigned to a range site; windbreak suitability group 10.

Scott Series

The Scott series consists of deep, poorly drained soils in upland depressions. These soils formed in loess. They are frequently ponded with runoff from adjacent areas.

In a representative profile the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is gray, very friable silt loam about 2 inches thick. The subsoil is about 44 inches thick. The upper part is grayish brown, very firm silty clay; the next part is light brownish gray, very firm silty clay; and the lower part is light brownish gray, firm silty clay loam. The underlying material is light gray silt loam to a depth of 60 inches.

These soils are frequently ponded. They absorb water slowly. Available water capacity is high. Permeability is very slow. Natural fertility is medium. Runoff from adjacent areas ponds on the surface until it evaporates or is slowly absorbed by the soil. During wet periods the soils are covered with water much of the time. During dry periods they are commonly dry, except where runoff from irrigated fields accumulates.

Scott soils are not well suited to cultivated crops because of the flooding. They can be cultivated, however, if protected from overflow. They are also poor for range because the vegetation is either unstable or undesirable as forage. Scott soils provide good food and cover for certain species of wildlife, mainly wetland wildlife. They also furnish excellent sites for certain kinds of recreation, for example, hunting waterfowl.

Representative profile of Scott silt loam, 0 to 1 percent slopes, in native vegetation, 2,100 feet south and 50 feet east of northwest corner of sec. 15, T. 4 N., R. 5 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, black (10YR 2/1) moist; moderate fine and medium granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

A2—6 to 8 inches; gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; weak thin platy structure; soft, very friable; slightly acid; abrupt smooth boundary.

B21t—8 to 23 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; yellowish brown (10YR 5/6) moist mottles; strong medium and coarse blocky structure; very hard, very firm; shotlike pellets (iron or manganese); neutral; clear smooth boundary.

B22t—23 to 39 inches; light brownish gray (10YR 6/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse blocky structure; very hard, very firm; numerous shotlike pellets (iron or manganese); neutral; gradual smooth boundary.

B3—39 to 52 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse subangular blocky structure; hard, firm; neutral; gradual smooth boundary.

C—52 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10 YR 5/2) moist; few distinct mottles, brownish yellow (10YR 6/6) moist; massive; slightly hard, friable; mildly alkaline; gradual smooth boundary.

Solum thickness ranges from 36 to 55 inches. The A1 horizon is 3 to 6 inches thick. The A2 horizon is 1 to 3 inches thick. The B horizon ranges in thickness from 30 to 45 inches. The B2t horizon is silty clay or clay and is 40 to 55 percent clay. The C horizon is mottled in places.

Scott soils are near Butler and Fillmore soils. They are more poorly drained and have a thinner A1 horizon than Butler soils. They have thinner A1 and A2 horizons and are ponded more frequently and for longer periods than Fillmore soils.

Sc—Scott silt loam, 0 to 1 percent slopes. This soil is in oval shaped depressions in the loess uplands. Areas range from 5 to 40 acres in size. Included in mapping were small areas of Butler and Fillmore soils at slightly higher elevations. Also included were a few small areas of Marsh at the lower elevations.

Excess water that accumulates as a result of runoff from higher lying soils is the main limitation. The commonly grown cultivated crops are ordinarily drowned out in years of above average rainfall. Where the claypan subsoil is within 6 inches of the surface, this soil is difficult to work because part of the sticky subsoil is incorporated into the plow layer during tillage. Drought is a hazard during periods of low rainfall because water movement is slow and root penetration is limited in the clayey subsoil. The claypan layer is very hard when dry and very sticky when wet.

Most of the acreage is used for pasture. Some areas are cultivated, but at the risk of crop damage or loss during most years. Grain sorghum is the most common crop. This soil is suitable for management of wetland wildlife. Capability unit IVw–2 dryland; not assigned to a range site; windbreak suitability group 10.

Uly Series

The Uly series consists of deep, steep, well drained soils. These soils are mainly on side slopes in the uplands. They formed in loess.

In a representative profile the surface layer is dark gray silt loam about 9 inches thick. The subsoil is about 15 inches thick. It is grayish brown, friable heavy silt loam in the upper part and pale brown, friable silt loam in the lower part. The underlying material is light gray silt loam to a depth of 60 inches.

Permeability is moderate, and available water capacity is high. Natural fertility is medium.

Uly soils are suited to native grass and are used for grazing. A few areas are cultivated, but the hazard of erosion is very severe. These soils are too steep for tree and shrub plantings. They furnish good habitat for wildlife.

Representative profile of Uly silt loam, 11 to 30 percent slopes, in native grass, 2,100 feet west and 100 feet south of northeast corner of sec. 30, T. 3 N., R. 8 W.

A—0 to 9 inches; dark gray (10YR 4/1) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B2—9 to 18 inches; grayish brown (10YR 5/2) heavy silt loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; slightly acid; clear smooth boundary.

B3—18 to 24 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

C1—24 to 31 inches; light gray (10YR 7 2) silt loam, light brownish gray (10YR 6/2) moist; weak coarse prismatic structure; slightly hard, very friable; mildly alkaline; gradual wavy boundary.

C2—31 to 48 inches; light gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; weak coarse prismatic structure; slightly hard, very friable; violent effervescence; mildly alkaline; gradual smooth boundary.

C3—48 to 60 inches; light gray (10YR 7/2) silt loam, pale brown (10YR 6/3) moist; light brownish gray (10YR 6/2) moist mottles; weak coarse prismatic structure; slightly hard, very friable; violent effervescence; mildly alkaline.

The A horizon is 6 to 12 inches thick. Thickness of the solum ranges from 12 to 30 inches. The B2 horizon is silt loam or light silty clay loam. The material between depths of 10 and 40 inches averages 18 to 29 percent clay. Depth to lime generally is about 28 inches, but ranges from 12 to 36 inches.

Uly soils are near Holder and Geary soils. Uly soils have less clay in the B2 horizon and have lime nearer the surface than Holder soils. They formed in material that is not so reddish as Geary soils and have less clay in the B2 horizon than those soils.

UyF—Uly silt loam, 11 to 30 percent slopes. This soil is on side slopes at the upper ends of upland drainageways. Areas range from 30 to 300 acres in size. This soil has the profile described as representative of the series. Included in mapping were some small areas of Geary silt loam on the lower part of the side slopes. Also included were small areas of Hobbs silt loam on the bottoms of the narrow drainageways.

The hazard of water erosion is very severe unless vegetative cover is adequate. Organic-matter content is moderate. Runoff is medium to rapid. Slopes are irregular. Catsteps occur in the steepest parts of this unit.

This soil is in native grass and is used mostly for grazing. Capability unit VIe-1 dryland; Silty range site; windbreak suitability group 10.

UyF2—Uly silt loam, 11 to 30 percent slopes, eroded. This soil is on smooth side slopes at the upper ends of drainageways that traverse uplands and on a few high stream terraces. Areas are irregular in shape and range from 10 to 100 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner and lighter colored and is heavy silt loam. Also, depth to lime is less. Included in mapping were small areas of Geary silty clay loam on the lower part of the side slopes. Some areas on the bottoms of intermittent drainageways are as much as 25 percent included Hobbs soils. The uneroded Uly soil makes up 5 to 15 percent of this unit.

The hazard of water erosion is very severe. Water erosion has removed most of the darkened surface layer, and tillage has mixed the rest with the upper part of the subsoil. In many areas numerous rills and small gullies have formed. Natural fertility on this eroded soil is low. Organic-matter content is low. Runoff is rapid.

This soil is not suited to the commonly grown cultivated crops because it is too steep and the hazard of erosion is too severe. About 60 percent of the acreage, however, is cultivated. The rest has been seeded to native grasses and is used for grazing. Capability unit VIe-8 dryland; Silty range site; windbreak suitability group 10.

Wann Series

The Wann series consists of deep, nearly level, somewhat poorly drained soils. These soils are on bottom land in the Republican River Valley. They formed in recent alluvium. Depth to the water table ranges from 2 feet in spring to 5 feet in fall.

In a representative profile the surface layer is very friable gray loam about 11 inches thick. Beneath this is a transition layer of very pale brown very fine sandy loam about 5 inches thick. The underlying material is light gray loamy very fine sand in the upper part and very pale brown loamy fine sand to a depth of 60 inches.

Permeability is moderately rapid, and available water capacity is moderate. Natural fertility is medium.

Wann soils are suited to cultivated crops. They are also suited to grass and to tree and shrub plantings. Many areas furnish good habitat for wildlife.

Representative profile of Wann loam, 0 to 2 percent slopes, in cultivated cropland, 2,640 feet south and 100 feet east of northwest corner of sec. 33, T. 1 N., R. 7 W.

Ap—0 to 5 inches; gray (10YR 5/1) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; violent effervescence; mildly alkaline; abrupt smooth boundary.

A12—5 to 11 inches; gray (10YR 5/1) loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

AC—11 to 16 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; violent effervescence; strongly alkaline; clear smooth boundary.

C1—16 to 38 inches; light gray (10YR 7/2) loamy very fine sand; pale brown (10YR 6/3) moist mottles; single grained; loose, very friable; slight effervescence; strongly alkaline; clear smooth boundary.

C2—38 to 60 inches; very pale brown (10YR 8/3) loamy fine sand, pale brown (10YR 6/3) moist; single grained; loose, very friable; slight effervescence; strongly alkaline.

The A horizon is loam or fine sandy loam and is 8 to 20 inches thick. The upper part of the C horizon is commonly fine sandy loam, but it ranges from loamy very fine sand to sandy loam and has a few thin strata of finer textured or coarser textured material. The lower part of the C horizon is loamy fine sand or loamy sand.

The Wann soils in this county contain more very fine sand than is typical, but this difference does not alter use and management.

Wann soils are near McCook, Cozad, and Munjor soils. They are not so well drained as McCook and Cozad soils and have more sand in the C horizon than those soils. They are more poorly drained than Munjor soils and also differ from those soils in having mottles in the C horizon.

Wb—Wann fine sandy loam, 0 to 2 percent slopes. This soil formed in loamy and sandy alluvium. Areas are commonly traversed by alternating low ridges and shallow channels. They are generally irregular in shape and range in size from 10 to 150 acres. This soil has a profile similar to the one described as representative of the series, but the surface layer is fine sandy loam. Included in mapping were small areas of Inavale, McCook, and Munjor soils at slightly higher elevations.

Wetness from the fluctuating water table is the chief limitation. It delays tillage in spring. This soil also remains cold longer in spring than better drained soils. The surface layer is friable and is easily tilled. Many areas are occasionally flooded for a short time following heavy rains. Organic-matter content is moderate. Runoff is medium to slow. Soil blowing is a concern if the soil has little vegetative cover, commonly late in summer when rainfall is lowest. Available phosphate is generally low because of the excess amount of lime in the soil. Maintaining a high and a balanced level of fertility is important.

Most of the acreage is cultivated. The rest is in grass and is used for grazing. Grain sorghum, alfalfa, and corn are the main dryland crops. A few areas are irrigated, mainly to grain sorghum and corn. Scattered trees are in a few areas. Capability units IIw–6 dryland, IIw–8 irrigated; Subirrigated range site; windbreak suitability group 2.

Wm—Wann loam, 0 to 2 percent slopes. This soil formed in loamy and sandy alluvium on low bottom land. Areas are traversed by many shallow channels and low ridges. They are generally long and range from 10 to 300 acres in size. This soil has the profile described as representative of the series. Included in mapping were areas of McCook and Munjor soils at slightly higher elevations.

A fluctuating water table makes this soil moderately wet. Tillage is commonly delayed in spring when the water table and local precipitation are highest. This soil is friable and unless wet, is easily tilled. Organic-matter content is moderate. Runoff is slow. A few areas having accumulations of excess soluble salt are identified on the soil map by spot symbols. The soil is occasionally flooded for short periods following heavy rains. Maintaining a balanced and high level of fertility is important. Available phosphate is generally low because of the excess lime in the surface layer.

Nearly all the acreage is cultivated. Grain sorghum, corn, and alfalfa are the main crops. A small acreage is in wheat. A few areas are irrigated, chiefly to grain sorghum and corn. Capability units IIw–4 dryland, IIw–8 irrigated; Subirrigated range site; windbreak suitability group 2.

Use and Management of the Soils

This section explains how the soils in Nuckolls County can be used. It defines the capability classification used by the Soil Conservation Service. It also suggests general management for dryland and irrigated soils. Yields of the principal dryfarmed and irrigated crops under improved management are listed in table 2 for each arable soil in the county.

About 65 percent of Nuckolls County is used for crops. According to the annual Nebraska Agricultural Statistics, the most extensive crops harvested in 1973 were grain sorghum, 90,000 acres; winter wheat, 42,500 acres; corn, 39,400 acres; and alfalfa hay, 12,700 acres. Other crops were oats, 1,000 acres; and soybeans, 700 acres. The rest of the acreage was cropped less extensively, fallowed, or idle.

This section also provides information on range, windbreaks, food and cover for wildlife, and engineering.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, trees, or engineering structures.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode, but have other limitations, impractical to remove, that limit their use largely to pasture or range or wildlife.

Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with

plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage) ; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in some parts of the United States but not in Nuckolls County, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–1 or IIIe–6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Dryland soils

The sequence of crops and the practices needed for use and conservation of the soil are considered in management. On dryfarmed soils, the cropping system should preserve tilth and fertility; maintain a plant cover that protects the soil from erosion; and control weeds, insects, and diseases. Cropping systems vary according to the soils. For example, the crop sequence on an eroded, strongly sloping Geary silty clay loam should include a high percentage of grass and legume crops. In contrast, on a nearly level Hastings silt loam, only a low percentage of grasses and legumes is needed.

For dryland farming, soils need to be worked to prepare a seedbed, to control weeds, and to provide a favorable place for plants to grow. Excessive tillage, however, breaks down the structure of such soils as the Hastings and Hord. Steps in the cultivation process should be limited to those that are essential. A reduction in tillage, for example, may reduce the cost of crop production.

In Nuckolls County, the till-plant method is well suited to row crops. Grasses can be established by drilling into a cover of stubble without further seedbed preparation. Wheat is commonly planted in the fall on land that has been summer fallowed (fig. 11). As protection against soil blowing and water erosion during the fallow period and the initial growth stage of the wheat, part of the previous crop residue should be retained on the surface. The process of tilling the soil and leaving residue on the surface during the fallow period is called stubble mulching.

Crop residue from all crops should be retained to protect the soil from blowing and from water erosion and to provide organic matter that can be returned to

Figure 11.—Winter wheat on Crete silt loam, 0 to 1 percent slopes.

the soil. Cropping systems should include crops that produce a good supply of long-lasting residue, for example, wheat, sorghum, and corn. The amount of residue needed to protect the soil depends on the kind of residue, the kind of soil, and the exposure of the field to damage by wind. Proper residue management is particularly important on moderately coarse textured soils, such as Inavale fine sandy loam and McCook fine sandy loam. The removal of crop residue by burning is not a desirable practice.

To control water erosion and to conserve moisture that would otherwise be lost on strongly sloping soils, ridge terraces can be constructed across slopes. The resulting furrows hold rainwater and thus decrease runoff and erosion. The additional water is absorbed by the soil, becomes available to crops, and improves productivity. Cultivation across the slope is known as contour farming. Terracing and contour farming are well suited to such soils as Holder silty clay loam, 3 to 6 percent slopes, eroded, and Hastings silt loam, 1 to 3 percent slopes. Less power is required for contour tilling than for tilling up and down the slope.

In order to conserve moisture on very gently sloping and gently sloping soils, level terraces can be constructed. The horizontal distance between terraces is determined by the slope and the kind of soil. If terraces are of the gradient type, grassed waterways are needed for the disposal of surplus water. In order to divert runoff in large areas, large grassed terraces, or diversion terraces, are used. Grassed waterways are needed for the disposal of surplus water.

Dryfarmed crops do not require as much fertilizer as irrigated crops. Many of the soils in Nuckolls County need nitrogen. Some benefit from phosphorus. Most have a neutral reaction in the surface layer and do not need lime. The kind and amount of fertilizer required should be determined by soil tests, field trials, and the needs of the crop.

Crops now dryfarmed in the county are well suited to the soils and climate, and the potential for suitable new crops is good. Transportation facilities are adequate for handling new crops if markets in the larger population centers are available.

On the following pages the capability units for dryland soils in Nuckolls County are described and the use and management of the soils is suggested.

CAPABILITY UNIT I-1 DRYLAND

This unit consists of deep, nearly level soils on bottom land, stream terraces, and uplands. The soils are well drained and moderately well drained. The surface layer is silt loam, and the subsoil or underlying layer is silt loam, very fine sandy loam, or silty clay loam.

Available water capacity is high, and moisture is released readily to plants. Permeability is moderate or moderately slow. Organic-matter content is moderate. Natural fertility is medium to high. The soils are easily penetrated by roots, are easy to till, and can be intensively farmed. Runoff is slow or medium.

The main concerns of management are maintaining a high fertility level and increasing the organic-matter content. During some years, there is a lack of sufficient moisture for dryfarmed crops, particularly during the hot summer.

These soils can be used for row crops year after year if fertility is maintained and the soil is protected from blowing. Keeping a cover of growing plants or crop residue on the surface helps to prevent soil blowing.

These soils are suited to grain sorghum, corn, small grain, alfalfa, and tame hay. Grain sorghum is better suited than corn in the upland areas. All soils of this unit are suited to windbreak plantings and to plantings that produce cover and food for wildlife.

CAPABILITY UNIT IIe-1 DRYLAND

This unit consists of deep, very gently sloping soils on uplands and stream terraces. The soils are well drained. The surface layer is loam, and the subsoil is silt loam or silty clay loam.

Available water capacity is high. Permeability is moderate to moderately slow. The soils absorb water easily and release it readily to plants. Organic-matter content is moderate. Natural fertility is medium to high. The soils are easily penetrated by roots, air, and water. Erosion is moderate. Runoff is medium.

Water erosion is the main hazard on these soils. Conserving moisture by reducing runoff is important. Maintaining a high fertility level and improving the moderate organic-matter content are other concerns of management.

Terraces, contour farming, and grassed waterways help reduce runoff and conserve moisture. A cropping system that keeps the soil covered with vegetation most of the time reduces moisture loss and soil blowing.

Grain sorghum, corn, small grain, alfalfa, and tame hay are suitable crops. These soils are also suited to windbreak plantings, and to plantings that produce food for wildlife. Grain sorghum is better suited than corn because it can endure longer dry periods.

CAPABILITY UNIT IIe-3 DRYLAND

McCook fine sandy loam, 0 to 2 percent slopes, is the only soil in this unit. It is a deep, nearly level, moderately well drained soil on bottom land. The underlying material is very fine sandy loam. This soil is calcareous throughout.

Available water capacity is high. The soil absorbs water easily and releases it readily to plants. Permeability is moderate. Runoff is slow. Natural fertility is high. This soil is easy to cultivate, and roots can penetrate it easily.

Protection from soil blowing is needed, and the organic-matter content should be improved. Phosphate is not readily available because of the high lime content. Maintaining a balanced fertility is a concern of management. Soil blowing can be reduced and moisture conserved by stripcropping and a cropping system that keeps the soil covered with growing crops or crop residue most of the time.

This soil is suited to corn, grain sorghum, small grain, alfalfa, and hay. It is also suited to windbreak plantings and habitat plantings for wildlife.

CAPABILITY UNIT IIw-2 DRYLAND

This unit consists of deep, nearly level, claypan soils on uplands. The soils are in shallow basins and depres-

sions. They are somewhat poorly drained or moderately well drained. The surface layer in a few areas has been thickened by land filling to provide for better surface drainage. The surface layer is silt loam, and the subsoil is silty clay.

,Available water capacity is high. Permeability is slow or very slow. The claypan subsoil restricts penetration of roots and moisture. Organic-matter content is moderate. Natural fertility is medium. Runoff is slow.

The surface layer does not dry out readily in spring. As a result, tillage is delayed and crop growth retarded. A complete crop loss, however, is infrequent. There is occasional flooding in some areas after heavy rains. Late in summer, however, when rainfall is lowest, the soils are droughty because the claypan subsoil does not allow effective moisture storage in the lower part of the profile.

Small grain, grain sorghum, corn, and alfalfa are suitable crops. These soils are marginally suited to windbreak plantings, but they are well suited to plantings that produce cover and food for wildlife. Grain sorghum is better suited than other crops because it withstands the occasional flooding following heavy rains and can endure more drought during dry periods. Occasional flooding in spring can limit production of small grain and alfalfa. Shallow ditches can be used to drain imponded surface water following heavy rains. Close-growing crops improve tilth and permeability of the soils and help keep the claypan open.

CAPABILITY UNIT IIw-3 DRYLAND

This unit consists of deep, nearly level soils on bottom land. The soils are flooded occasionally for short periods. The surface layer is loam or silt loam, and the underlying material is silt loam or fine sandy loam.

Available water capacity is high or moderate. The soils absorb moisture easily and release it readily to plants. Permeability is moderate or moderately rapid. Organic-matter content is moderate. Natural fertility is medium or high. Runoff is slow.

These soils are commonly flooded for short periods after heavy rains in spring. As a result, tillage is delayed. Damage to crops, however, is seldom severe. In dry years the moisture from overflow can benefit crops unless the plants are too small or the water flows too rapidly.

These soils are suited to corn, grain sorghum, small grain, alfalfa, and hay. They are also suited to windbreak plantings and to plantings that produce cover and food for wildlife. Flooding in spring occasionally delays planting and cultivation and limits production of small grain and alfalfa. During dry periods, however, occasional flooding is beneficial to crops because it adds to the total supply of moisture.

In most areas diversions and drainage ditches are needed to intercept runoff and thus keep it from spreading over a wide area. Maintaining the drainage ditches and diversions is a concern of management.

CAPABILITY UNIT IIw-4 DRYLAND

This unit consists of deep, nearly level soils on bottom land. The water table fluctuates between depths of 2 and 6 feet. The surface layer is loam or silt loam, and the underlying material is silt loam to loamy very fine sand.

Available water capacity is moderate or high. The soils generally absorb moisture well and release it readily to plants. Permeability is moderate or moderately rapid. Organic-matter content is moderate. Natural fertility is medium to high.

During periods of excessive moisture, the high water table rises and thus delays tillage. These soils warm more slowly in spring than better drained soils. Balancing plant nutrients is a management concern because the surface layer is high in lime. Most of the phosphate, therefore, is unavailable to crops.

These soils are suited to corn, grain sorghum, and alfalfa. They are not so well suited to spring-sown small grain because the water level is high in spring and interferes with timely tillage. The soils are also suited to trees and habitat for wildlife.

If suitable outlets are available, drainage ditches and tile drains can help control wetness and the high water table. Phosphate fertilizer can be applied to the soils to provide available phosphorus.

CAPABILITY UNIT IIw-6 DRYLAND

Wann fine sandy loam, 0 to 2 percent slopes, the only soil in this unit, is a deep, nearly level soil on bottom land. The water table fluctuates between depths of 2 to 8 feet. The underlying material is loamy very fine sand. This soil is calcareous throughout.

Available water capacity is moderate. The soil generally absorbs water easily and releases it readily to plants. Permeability is moderately rapid. Organic-matter content is moderate, and natural fertility is medium. Runoff is slow.

In spring the high water table and occasional flooding delay tillage. Damage to crops, however, is seldom severe. Soil blowing is a hazard unless the surface is protected.

If suitable outlets are available, drainage ditches and tile drains are needed. Soil fertility can be maintained or increased by using commercial fertilizers, mainly phosphorus and nitrogen. During extended dry periods, soil blowing can be reduced by stripcropping and a cropping system that keeps the soil covered with growing crops or crop residue.

Corn, grain sorghum, and alfalfa are well suited to this soil. Spring-sown small grain is not so well suited because the water table is high in spring. The high water table drowns alfalfa in some areas during extended wet periods. This soil is also suited to trees and to plantings that produce food for wildlife.

CAPABILITY UNIT IIs-2 DRYLAND

Crete silt loam, 0 to 1 percent slopes, the only soil in this unit, is a deep, nearly level, claypan soil on uplands. It is moderately well drained. The subsoil is silty clay.

Available water capacity is high. The claypan subsoil restricts penetration of roots and moisture. The soil is droughty, especially during extended dry periods. Permeability is slow. Organic-matter content is moderate, and natural fertility is medium to high. Runoff is slow, and the hazard of erosion is only slight. This soil is droughty because the subsoil absorbs moisture slowly,

restricts its movement to lower depths, and releases it slowly to plants.

Runoff should be prevented in order to increase soil moisture. Opening the subsoil to air and moisture is also a concern of management. Growing alfalfa and other close-growing crops improves the tilth and permeability of this soil and helps keep the claypan open.

This soil is suited to grain sorghum, corn, small grain, and alfalfa. It is also suited to windbreak plantings and habitat plantings for wildlife. Grain sorghum and wheat are generally better suited than other crops because grain sorghum can withstand longer periods without rainfall and wheat grows and matures in spring when rainfall is highest.

CAPABILITY UNIT IIIe-1 DRYLAND

This unit consists of gently sloping soils on uplands and stream terraces. The soils are deep or moderately deep over mixed sand and gravel. The surface layer is silt loam, and the subsoil is silty clay loam, clay loam, or silt loam.

In most areas available water capacity is high. In a few it is low. These soils absorb water well and release it readily to plants. Permeability is moderate to moderately slow in the surface layer and subsoil, but is very rapid in the mixed sand and gravel. Organic-matter content is moderate or moderately low. Natural fertility ranges from low to high. Runoff is medium. These soils generally are easy to work and can be readily penetrated by roots.

In some small areas, part of the original surface layer has been removed, mainly by water erosion. Controlling runoff and conserving moisture are the main concerns of management if these soils are cultivated. Maintaining high fertility is a further concern.

These soils are suited to grain sorghum, corn, small grain, and alfalfa. Grain sorghum is generally better suited than corn because it can survive longer during periods of low rainfall. The soils are also suited to windbreak plantings and to plantings that produce food for wildlife.

Terraces, grassed waterways, contour farming, and a mulch of crop residue reduce runoff and help control erosion. A cropping system that keeps the soil covered with crops or crop residue most of the time conserves moisture and helps control water erosion. Limiting the years of consecutive row crops, managing the crop residue, and increasing the number of close-growing crops in the cropping system are beneficial. Minimum tillage, which keeps residue on the surface during seedbed preparation, is needed for erosion control.

CAPABILITY UNIT IIIe-3 DRYLAND

Inavale fine sandy loam, 0 to 2 percent slopes, the only soil in this capability unit, is a somewhat excessively drained soil on bottom land. The underlying material is loamy sand. Depth to the fluctuating water table ranges from 5 to 10 feet.

Available water capacity is very low. Permeability is rapid. The soil absorbs water easily and releases it readily to plants. Organic-matter content and natural fertility are low.

Soil blowing is the main hazard on this soil. Loss of fertility by leaching and conservation of moisture are also important management concerns. The soil is droughty because it stores little water and because the large pore spaces allow rapid movement of water through the soil.

Narrow, alternate fields of row crops and small grain and minimum tillage, which keeps residue on the surface most of the time, reduce the hazard of soil blowing and conserve moisture.

Grain sorghum, corn, small grain, and alfalfa are suitable crops. The soil is suited to certain trees and to plantings that produce food and cover for wildlife.

CAPABILITY UNIT IIIe-8 DRYLAND

This unit consists of deep, gently sloping soils on uplands. The surface layer and subsoil are silty clay loam. These soils are severely eroded.

Available water capacity is high. Permeability is moderately slow or moderate. These soils absorb water slowly, but release it readily to plants. Organic-matter content and natural fertility are low. Runoff is medium to rapid, depending on the amount of vegetative cover.

These soils are subject to severe sheet, rill, and gully erosion. Nearly all of the original dark colored surface layer has been washed away. Small gullies are common. Maintaining good tilth, improving fertility, controlling runoff, reducing erosion, and conserving moisture are the main concerns of management.

Terraces, grassed waterways, contour farming, and crop residue left on the surface help prevent erosion, conserve moisture, and control runoff. Keeping tillage to a minimum which leaves residue on the surface, and returning crop residue to the soil improve the organic-matter content and help maintain productivity.

These soils are suited to grain sorghum, corn, small grain, alfalfa, and grass. Row crops are not so well suited as small grain, grass, and alfalfa because runoff after rainfall results in moisture loss and severe erosion. The soils are also suited to windbreak plantings and to plantings that produce food and cover for wildlife.

CAPABILITY UNIT IIIw-2 DRYLAND

Fillmore silt loam, 0 to 1 percent slopes, the only soil in this unit, is a deep, poorly drained soil that has a claypan subsoil. It is in shallow depressions of the uplands. It is occasionally flooded by water that runs in from surrounding, higher lying areas. The subsoil is silty clay.

Available water capacity is high. The soil absorbs water slowly and releases it slowly to plants. Permeability is very slow. Organic-matter content is moderate, and natural fertility is medium. Unless wet, the surface layer is easy to work. The compact, fine textured subsoil reduces the movement of air and water and restricts root penetration, particularly when the soil is dry.

Water ponding on the surface produces excessive soil wetness, particularly in spring, when rainfall is heaviest. This wetness delays tillage in preparation for spring-sown crops. During the dry summer, however, the soil is droughty unless rains are timely. Drainage outlets are not easily provided in most areas.

Shallow drains can be used to drain impounded surface water if suitable outlets are available. Terraces and diversions on the adjoining higher lying soils help to control excessive wetness in the depressional areas. Returning crop residue improves tilth.

Small grain and grain sorghum are suitable crops. Alfalfa and corn are not well suited because of the occasional flooding. Some species of trees are suited. Wildlife use areas of this soil for cover and nesting and as a source of food.

CAPABILITY UNIT IIIw-3 DRYLAND

Munjor soils, 0 to 2 percent slopes, makes up this unit. These deep, moderately well drained soils are on bottom land. The surface layer is dominantly silt loam, but areas of loam and fine sandy loam are also included. The underlying material is loamy fine sand and very fine sandy loam.

Permeability is moderately rapid. Available water capacity is moderate. Organic-matter content is moderate. Natural fertility is medium to low. Runoff is slow.

These soils are flooded occasionally with overflow from the Republican River. The water table is at a depth of 4 to 8 feet. The excess lime in the surface layer makes much of the phosphate unavailable to plants. Late in summer, when the water table is lowest, a lack of adequate moisture limits crop growth on dryfarmed fields.

Diversions and management of the drainage area above these soils are beneficial in reducing flood damage. Minimum tillage, which keeps residue on the surface most of the time, conserves moisture, improves organic-matter content, and reduces scouring damage caused by floodwater. Fertility can be maintained by additions of commercial fertilizer, particularly phosphorus and nitrogen.

These soils are suited to grain sorghum and alfalfa. Small grain is not well suited. Crops are subject to damage from occasional flooding in spring following heavy rains. The soils are droughty during hot, dry periods late in summer. They are suited to certain tree species for windbreaks. Wildlife use areas of these soils for cover and nesting and as a source of food.

CAPABILITY UNIT IVe-1 DRYLAND

This unit consists of strongly sloping soils on uplands. These soils are deep or are moderately deep over mixed sand and gravel. The surface layer is silt loam, and the subsoil is silt loam or silty clay loam.

In most areas available water capacity is high. In a few it is low. These soils are too sloping to absorb water easily, but they release it readily to plants. Permeability is mainly moderate or moderately slow, but is very rapid in the sand and gravel. Organic-matter content is moderate. Natural fertility ranges from low to high. Runoff ranges from medium to rapid. These soils are easy to work and are readily penetrated by roots.

Erosion is only slight, but sheet, rill, and gully erosion are serious hazards of these strongly sloping soils. Maintaining high fertility, controlling runoff, reducing erosion, and conserving moisture are the main concerns of management.

Terraces, grassed waterways, contour farming, crop residue, minimum tillage which keeps residue on the surface, and a suitable cropping system are needed to reduce the risk of erosion, control runoff, and conserve moisture. A protective cover of grass on the soil after the grazing season reduces the hazard of water erosion on range.

These soils are suited to alfalfa, grasses, and wheat. The use of these soils for grain sorghum and corn should be limited. The soils are also suited to pasture, range, windbreak plantings, habitat for wildlife, and recreation.

CAPABILITY UNIT IVe-5 DRYLAND

Inavale loamy fine sand, 0 to 2 percent slopes, is the only soil in this unit. It is a deep, somewhat excessively drained soil on bottom land. The underlying material is loamy sand.

Available water capacity is very low. Permeability is rapid. The soil absorbs water easily and releases it readily to plants. Organic-matter content and natural fertility are low. Runoff is slow because most of the rainfall is absorbed nearly as rapidly as it falls.

Soil blowing is a serious hazard if this soil is cultivated. Improving fertility and conserving soil moisture are important management concerns. This soil is droughty in summer, when rainfall is lowest.

Soil blowing can be reduced, moisture conserved, and organic-matter content and fertility maintained by using a cropping system that keeps the soil covered with crops, grass, or crop residue. Soil blowing can also be reduced by stripcropping, minimum tillage which keeps residue on the surface, grassed field borders, and narrow tree windbreaks.

Grain sorghum, small grain, corn, and alfalfa are well suited because they grow and mature in spring, when moisture is plentiful. This soil is also suited to certain species of trees for windbreaks. Wildlife use areas of this soil for cover and nesting and as a source of food.

CAPABILITY UNIT IVe-8 DRYLAND

This unit consists of strongly sloping soils on uplands. The soils are mostly deep, but in a few areas they are only moderately deep over mixed sand and gravel. They are severely eroded. Nearly all of the original dark colored surface layer has been washed away, and tillage is in the original subsoil material. The surface layer is silty clay loam, and the subsoil is silty clay loam or clay loam.

These soils are too sloping to absorb water easily, but they release moisture readily to plants. Runoff is rapid. Available water capacity is mainly high, but is low in the coarse material. Premeability is mostly moderately slow or moderate, but is very rapid in the mixed sand and gravel. Organic-matter content and fertility are low. Roots commonly penetrate the soils easily, but they are severely restricted in the sand and gravel. The soils are not easy to work because they are firm when moist and lack good tilth.

These soils are subject to severe sheet, rill, and gully erosion. Improving soil tilth and fertility, controlling runoff, rdeucing the risk of erosion, and conserving soil moisture are the principal concerns of management.

These soils are best suited to close-grown crops, such as alfalfa, grass, and small grain. A cropping system that limits corn and grain sorghum to 1 year and alternates these crops with small grain, alfalfa, and hay reduces the hazard of water erosion. These soils are also suited to pasture, range, windbreak plantings, and plantings that produce cover and food for wildlife.

Terraces, contour farming, and grassed waterways are needed to supplement the cropping practices. Maintaining crop residue on the surface with minimum tillage is a satisfactory way to check soil loss, conserve moisture, and control runoff. The hazard of water erosion can also be reduced by converting the entire acreage to grassland. Establishing a protective cover of grass in seeded areas after the grazing season also reduces the hazard of water erosion.

CAPABILITY UNIT IVw-2 DRYLAND

Scott silt loam, 0 to 1 percent slopes, the only soil in this unit, is a deep, poorly drained soil that has a claypan type subsoil. This soil is in upland depressions that are frequently flooded. The surface layer is thin. The subsoil is silty clay.

Available water capacity is high. This soil absorbs water slowly and releases it slowly to plants. Permeability is very slow. Organic-matter content is moderate. Natural fertility is medium.

Wetness during part or all of the year is the main hazard. Surface drainage is not easy because the depressions lack natural drainage outlets. Unless the areas are drained, tillage and harvesting are difficult. The claypan subsoil restricts movement of air and water and penetration of roots. Tillage is difficult because the surface layer is thin and tillage commonly includes some of the upper part of the subsoil.

Grain sorghum and wheat are better suited to this soil than are most other crops. Corn, alfalfa, and grass can also be grown, but they are not so well suited. Shallow drains can be used to drain impounded surface water if suitable outlets are available. There is a possibility, in some areas, for controlling the excessive wetness by installing terraces and diversions on the adjacent higher lying soils. Planting deep-rooted crops and incorporating crop residue during tillage help improve tilth and permeability.

This soil is also suited to development as wetland for wildlife. Where the adjacent areas are irrigated and runoff is evident, areas of this soil are commonly waterlogged during most of the summer and are valuable wetland for wildlife.

CAPABILITY UNIT VIe-1 DRYLAND

This unit consists of steep upland soils that are deep and moderately deep over mixed sand and gravel. The surface layer and subsoil are silt loam or silty clay loam.

These soils are too steep to absorb water readily but they release it readily to plants. In most areas available water capacity is high. It is low in a few areas that have sand and gravel in the underlying material. Permeability is generally moderate to moderately slow, but is very rapid in the mixed sand and gravel. Organic-matter content is moderate or low. Natural fertility is medium to high. Runoff is rapid. Roots penetrate these soils easily.

Water erosion is a very severe hazard. The soils are too steep and too erodible for the commonly grown cultivated crops. Gullies easily form. Controlling runoff during rainfall is an important concern of management.

Proper grazing use and a planned grazing system help to maintain and improve stands of grass and reduce soil loss. Weeds and brush can be controlled by spraying. Stock water dams, erosion control structures, and floodwater detention reservoirs can be built in drainageways.

These soils are suited only to rangeland, hayland, and other less intensive uses. Areas of these soils that are cultivated can be seeded to native grasses and thus converted to rangeland. The soils are also suited to trees and to the development of wildlife habitat and recreation areas.

CAPABILITY UNIT VIe-8 DRYLAND

This unit consists of deep, steep soils on uplands. These soils are severely eroded, and nearly all the original dark colored surface layer has been washed away. Both the surface layer and subsoil are silt loam or silty clay loam.

Runoff is rapid, and gully erosion is common. Available water capacity is high. Permeability is moderate or moderately slow. Organic-matter content and fertility are low. Roots penetrate the soils easily. Water is not absorbed readily because the slope is steep and tilth is poor.

Water erosion is a very severe hazard on these soils, and gullies are common. The main management concerns are keeping an adequate cover on the soil surface and conserving moisture by slowing runoff. The organic-matter content should be increased, and tilth should be improved.

Good management is needed to establish and maintain a vigorous stand of grasses. A cover crop can be used during establishment of the grass to control erosion. Proper grazing use, deferred grazing, and control of weeds and brush help in reducing runoff, controlling erosion, and conserving moisture. A good range management system controls most weeds. Troublesome areas may require spraying. Dams for livestock water, erosion control structures, and flood detention reservoirs can be built in drainageways.

These soils are not suitable for cultivation because they are too steep and erodible. Most of the acreage, however, is cultivated. Reseeding cultivated areas to native grass and converting them to range is a good practice on these soils. These soils are also suited to trees and to the development of recreation areas and habitat for wildlife.

CAPABILITY UNIT VIs-1 DRYLAND

The only mapping unit in this unit is Saline-alkali land. It consists of stream sediment that is affected by excess soluble salts and high alkalinity. The soil ma-

terial is variable in texture, ranging from sandy loam to clay loam. Areas are kept wet by moisture from seepage, surface flooding, and a moderately high water table.

This soil material is poorly drained. Excess salinity, high alkalinity, and excessive wetness make this land unsuited to the commonly grown cultivated crops. The material is difficult to work because it is wet. Fertility is low and is not well balanced.

Where suitable outlets are available, tile drains or open drainage ditches help to lower the water table and control wetness. Good grassland management, such as proper stocking and deferred grazing, is needed to maintain a good cover of grass. Where areas are plowed in order to establish a new stand of grass, barnyard manure can be applied to improve the tilth and fertility. Phosphate fertilizer can also be used to improve the fertility and the stand of legumes. Weeds can be controlled by spraying.

This land is not well suited to cultivation because of the excessive salinity and high alkalinity, but is well suited to alkali-tolerant grasses. It provides limited cover and food for wildlife.

CAPABILITY UNIT VIs-4 DRYLAND

This unit consists of soils that are shallow over bedrock or mixed sand and gravel. These are strongly sloping to steep soils on uplands. They are excessively drained or somewhat excessively drained. The surface layer is silt loam or loam, and the underlying material ranges from silt loam to mixed sand and gravel.

Available water capacity is low. Permeability is generally moderate, but it is very rapid in the sand and gravel of some areas. Runoff is medium to rapid. Natural fertility is medium to low. Organic-matter content is moderate to low. Moisture is not absorbed easily where the soil is over bedrock. After moisture is absorbed, however, the water is released readily to plants. Moisture is easily absorbed where the soil is over sand and gravel.

The soils overlying gravel are less stable than those overlying bedrock. All are droughty because they hold little moisture. Reducing runoff and conserving the available moisture are the main concerns of management. Controlling erosion is also important on the steep soils.

Proper stocking, a planned grazing system, and control of weeds and brush help to maintain vigor of the grasses. Maintaining a good cover of vigorous grass reduces the hazard of runoff and conserves moisture on the steep soils. Stock water dams can be built in some drainageways to provide water for livestock and wildlife. Troublesome areas of weeds can be controlled by spraying.

These soils are suited to range, and most of the acreage is used for this purpose. The soils are well suited to habitat for wildlife and provide recreational areas. Trees can be grown in some drainageways, but are not suited in the areas of shallow soils.

CAPABILITY UNIT VIw-7 DRYLAND

Hobbs silt loam, channeled, 0 to 3 percent slopes, is the only soil in this unit. It is on bottom land of major drainageways. Texture is mainly silt loam, loam, and silty clay loam. This soil is commonly broken into small inaccessible areas by steep streambanks and crooked channels.

Permeability is moderate. Available water capacity is high. Moisture is easily absorbed and readily released to plants. Organic-matter content is variable but in most places is moderate. Runoff is medium.

This soil is flooded several times each year. At times, debris and trash are deposited by the floodwaters. Silt is added with each flood, but some is also removed by the scouring action of the water. The soil remains covered with water for an hour to several days, depending on intensity of the flood.

Erosion control structures can be built if sites are carefully selected. Large floodwater detention structures can be used to reduce flooding in areas below the structures. Troublesome weeds can be controlled by spraying.

It is not practical to cultivate areas of this soil. Most areas have a cover of mixed grasses, trees, brush, and weeds. This soil is generally used for grazing or as habitat for wildlife. If the grasses are allowed to reseed, existing stands will thicken. Many areas are densely wooded.

CAPABILITY UNIT VIIw-7 DRYLAND

Sandy alluvial land, the only mapping unit in this unit, is on bottom land, sand bars, and sand flats adjacent to flowing streams and also in old abandoned stream channels. The soil material ranges from sandy loam to loamy sand and mixed sand and gravel.

Permeability is rapid or very rapid. Available water capacity is low. Organic-matter content is generally low. Natural fertility is low. The soil material absorbs moisture easily and releases it readily to plants. Runoff is slow or medium.

Frequent flooding, several times a year, is a serious hazard. Trash and debris are commonly deposited by the floodwater.

Sandy alluvial land is not suitable for cultivation. In the more stabilized areas it supports sparse stands of annual weeds, common reedgrasses, and trees. It provides habitat for wildlife and limited grazing. Troublesome weeds can be controlled by spraying.

CAPABILITY UNIT VIIIw-7 DRYLAND

Marsh, the only mapping unit in this unit, is on bottom land of stream valleys and in depressions of the uplands. The bottom land areas have a water table near or at the surface most of the time. Depressions are frequently flooded by water that runs in from higher elevations. Marsh is very poorly drained.

Permeability ranges from slow in areas of upland depressions to rapid in some areas on bottoms. All areas are ponded, lacking natural outlets for drainage.

The growth and kind of vegetation is determined by the depth of water and the time of year that areas are inundated. During most of the growing season, the areas have 3 to 18 inches of water on the surface. A small acreage is open water.

Marsh is suitable only for wildlife habitat. Aquatic plants, such as common reedgrass, cattails, and rushes,

are the main vegetation, along with scattered clumps of willows and annual weeds. Marsh provides excellent habitat for waterfowl and some cover for upland game. Areas are used mainly for hunting.

Irrigated soils

Corn is the most important irrigated crop in Nuckolls County (fig. 12). Grain sorghum, soybeans, alfalfa, forage sorghum, and some grasses are also irrigated. In 1969, the irrigated area totaled about 28,417 acres.

On the level tableland in the northeastern and east-central parts of the county, irrigation water is obtained mainly from deep wells. In the Republican River Valley, water is obtained from open canals. The water is pumped directly from the river and also from a few shallow wells.

The irrigation water is distributed by furrows, corrugations, controlled flooding systems, or sprinklers. Different methods of distribution are suited to different crops and to different soils. For gravity irrigation, some land leveling is generally needed for more efficient use of the water. Sprinkler systems can be used efficiently on nearly level to gently sloping soils, such as the coarse textured Inavale soils and the moderately coarse textured Munjor soils. Mechanical or vegetative practices can be used to control water erosion and soil blowing.

The method of irrigation commonly is changed when converting from a row crop to a close-growing crop. Because this change is difficult where slopes are more than 2 percent, some farmers bench level their land so that the slope of the bench is less than 1 percent. Bench leveling is well suited to the gently sloping and very gently sloping Holder and Hastings silt loams. In leveling the deep, nearly level Crete soils, care must be taken not to expose the fine textured subsoil, which is generally not well suited to tillage. Such exposure reduces the intake rate and results in poor stands of crops as a result of crusting.

Figure 12.—**Irrigated corn on Hord silt loam, 0 to 1 percent slopes.**

On irrigated land, erosion by water can be controlled only by careful planning. Terracing and contour farming in strongly sloping areas and bench leveling in gently sloping areas provide effective control. Close-growing crops, such as alfalfa and small grain, tend to hold the soil in place better than row crops. Plowing under crop residue and green manure crops, adding barnyard manure, and using a stubble-mulch system of farming help to keep water erosion to a minimum. Soils that can benefit from some or all of these practices are Hastings silt loam, 3 to 6 percent slopes, and Holder silty clay loam, 6 to 11 percent slopes, eroded. Crop residue left after harvesting conserves moisture in the soil and helps prevent soil blowing late in fall and in winter. Leaving crop residue is particularly important on the weak structured Inavale, Cass, and Wann soils.

Because irrigated soils produce larger yields than dryfarmed soils, more plant nutrients are removed when the soil is irrigated. To keep irrigated soils fertile, crop residue should be returned to the soil and mineral fertilizers can be added to replace lost nutrients. Nitrogen is commonly needed for nonlegume crops. Phosphorus can be added to the somewhat poorly drained Gibbon and Wann soils, and zinc can be applied to eroded soils, such as the Holder soils, 3 to 6 percent slopes, eroded. The kind and amount of fertilizer needed for specific crops should be based on the results of soil tests.

Crops now irrigated in the county are well suited to the soils and climate, and there is a ready market for the products. The total acreage of irrigated crops can be increased by using sprinkler systems on the gently sloping and strongly sloping soils if sufficient water is available. Additional irrigation is suitable on the silty soils if sufficient water is available.

Farmers needing technical help in planning irrigation can contact the local office of the Soil Conservation Service and the county agricultural agent. Information about costs and equipment can be obtained from equipment dealers.

On the following pages the capability units for irrigated soils in Nuckolls County are described and the use and management of the soils is suggested.

CAPABILITY UNIT I-4 IRRIGATED

This unit consists of deep, nearly level soils on uplands and stream terraces. These soils are well drained. The surface layer is silt loam, and the subsoil is silty clay loam.

Permeability is moderately slow. Available water capacity is high. These soils absorb moisture easily and release it readily to plants. Organic-matter content is moderate, and natural fertility is medium to high. These soils are easy to work and are readily penetrated by roots. Runoff is medium.

Maintaining a high fertility level is the main concern of management. All types of irrigation systems are suited. Where a gravity system is used, however, slight irregularities in the surface can make it difficult to secure uniform distribution of water unless the land is leveled. Irrigation water should be applied in suffi-

cient amounts to serve the needs of the crop and at a rate that permits maximum absorption and minimum runoff. Management that reduces or controls irrigation runoff at the ends of fields is also necessary. Crop residue left on the surface in winter helps to reduce soil blowing.

These soils are suited to corn, grain sorghum, small grain, and alfalfa and to tame grasses for hay and pasture.

CAPABILITY UNIT I-6 IRRIGATED

This unit consists of deep, nearly level soils on bottom land and stream terraces. The soils are well drained. The surface layer is silt loam, and the subsoil is silt loam or very fine sandy loam.

Permeability is moderate. Available water capacity is high. The soils absorb moisture easily and release it readily to plants. Organic-matter content is moderate. Natural fertility is medium or high. The soils are easy to work and are readily penetrated by roots. Runoff is slow.

Maintaining a high fertility level is the main concern of management.

The soils are suited to corn, grain sorghum, small grain, and alfalfa and to tame grasses for hay and pasture. All types of irrigation are suited. For efficient gravity irrigation, some land grading is needed. Land grading helps to distribute irrigation water evenly and reduces leaching of fertilizer below the root zone. Controlling and conserving irrigation runoff at the ends of the fields is essential. Crop residue on the surface increases the water intake rate and reduces the hazard of soil blowing.

CAPABILITY UNIT IIe-4 IRRIGATED

This unit consists of deep, very gently sloping soils on uplands. These soils are well drained. The surface layer is silt loam, and the subsoil is silty clay loam.

Permeability is moderate or moderately slow. Available water capacity is high. The soils absorb moisture easily and release it readily to plants. Organic-matter content is moderate. Natural fertility is medium to high. The soils are easy to work and are readily penetrated by roots. Runoff is medium.

The hazard of erosion is moderate. Other concerns of management are reducing runoff and water waste by proper and timely water application and maintaining a high fertility level and good tilth. Contour benches or contour furrows supplemented by terraces can be used in surface irrigation. Sprinkler irrigation is also suitable. Careful control of the irrigation water is needed to prevent runoff and soil loss. Controlling and reducing runoff at the end of the field is essential for water conservation. Crop residue on the surface increases the water intake rate and provides a protective cover.

Corn and grain sorghum are the main crops. A limited acreage is in alfalfa, small grain, and tame grasses.

CAPABILITY UNIT IIe-5 IRRIGATED

McCook fine sandy loam, 0 to 2 percent slopes, the only soil in this unit, is a deep, nearly level soil on bottom land. It is moderately well drained. The surface layer and underlying material are fine sandy loam. The water table fluctuates between depths of 4 and 6 feet.

Permeability is moderate. Available water capacity is high. The soil absorbs moisture easily and releases it readily to plants. Organic-matter content is moderate. Natural fertility is high. This soil is easy to work and is readily penetrated by roots. Runoff is slow.

Soil blowing is a hazard where this soil is cultivated. Maintaining a balanced fertility level, increasing organic-matter content, and distributing irrigation water evenly are important concerns of management. Furrows and borders are the most common methods of irrigation. Sprinkler irrigation is effective in some areas of sloping or irregular topography. The moderate water intake rate of this soil makes it necessary to limit the length of field irrigation runs. Reducing and controlling irrigation runoff at the end of the field is essential for effective water conservation. A growing crop or crop residue on the surface reduces soil blowing.

This soil is well suited to corn, grain sorghum, small grain, alfalfa, and tame grasses.

CAPABILITY UNIT IIe-6 IRRIGATED

Hord silt loam, 1 to 3 percent slopes, is the only soil in this unit. It is a deep, very gently sloping soil on stream terraces. It is well drained. The subsoil is silt loam.

Available water capacity is high. Permeability is moderate. The soil absorbs moisture easily and releases it readily to plants. Organic-matter content is moderate, and natural fertility is medium to high. This soil is easy to work and is readily penetrated by roots. Runoff is medium.

The hazard of erosion is moderate. The main concerns of management are reducing runoff and waste of water by timely water application and maintaining a high fertility level. For surface irrigation, the field can be graded for contour benches or contour furrows and supplemented with terraces. Sprinkler irrigation is generally used on close-growing crops. Irrigation water should be applied in sufficient amounts to serve the needs of the crop and at a rate that permits maximum absorption and minimum runoff. Re-use of irrigation runoff water at the end of the field is essential for water conservation.

This soil is suited to corn, grain sorghum, alfalfa, small grain, and tame grasses.

CAPABILITY UNIT IIw-2 IRRIGATED

This unit consists of deep, nearly level soils on uplands and in shallow depressions of uplands. These soils are somewhat poorly drained or moderately well drained. The surface layer is silt loam, and the subsoil is silty clay.

Permeability is slow. Available water capacity is high. The soils absorb moisture slowly and release it slowly to plants. Organic-matter content is moderate. Natural fertility is medium. The surface layer is easy to work. The compact claypan subsoil restricts penetration of roots and reduces the movement of air and water. Runoff is slow.

Providing surface drainage for the excessive water that runs in from adjacent areas is the main concern of management. Proper and timely water management is needed to reduce crop stress during extremely dry periods. Keeping the fertility level high and improving permeability of the subsoil are other important concerns.

All types of irrigation are suited. Some land grading is needed to prepare the soils for irrigation. Including alfalfa in the cropping system helps to open the subsoil and thus aids the movement of air and water through the soil. The slow intake of water makes long periods of irrigation necessary. An irrigation system that diverts or intercepts floodwater following heavy rains is needed. Water management that controls and reduces excessive runoff of irrigation water is needed in conserving water during dry periods.

These soils are best suited to grain sorghum, corn, and alfalfa. They are also suited to small grain and grasses.

CAPABILITY UNIT IIw-6 IRRIGATED

This unit consists of deep, nearly level soils on bottom land. The surface layer and subsoil are silt loam.

Available water capacity is high or moderate. Permeability is moderate. These soils absorb moisture easily and release it readily to plants. Organic-matter content is moderate, and natural fertility is medium to high. The soils are easy to work and are readily penetrated by roots. Runoff is medium to slow.

Flooding or a high water table commonly delays tillage in spring. Maintaining a balanced fertility level is a concern of management. An irrigation system that diverts or intercepts underground water and floodwater is needed. For border or furrow irrigation, land grading is generally needed to provide adequate surface drainage. Sprinklers are suitable in areas where land grading is impractical. Excessive water leaches nutrients to a depth below plant roots. If the soil is calcareous at the surface, phosphate fertilizer is needed.

Crops suitable for these soils are corn, grain sorghum, alfalfa, and tame grasses.

CAPABILITY UNIT IIw-8 IRRIGATED

This unit consists of deep, nearly level soils on bottom land. These soils are well drained or somewhat poorly drained. The surface layer is loam or fine sandy loam, and the underlying material is mainly fine sandy loam. These soils are flooded occasionally or have a water table at a depth of 2 to 5 feet.

Permeability is moderately rapid. Available water capacity is high or moderate. The soils absorb moisture easily and release it readily to plants. Organic-matter content is moderate. Natural fertility is medium or low. The soils are easy to work and are readily penetrated by roots. Runoff is medium to slow.

Flooding or the moderately high water table delays preparation of a seedbed and planting in spring. Available phosphate is low in some areas. Maintaining a balanced fertility level and increasing the organic-matter content are other concerns of management.

An irrigation system that diverts or intercepts floodwater is needed in some areas. Land grading is needed if furrows or borders are used, but deep cuts are to be avoided because of the hazard of contacting coarse textured material. Sprinklers are suitable in areas where land grading is impractical. Small, frequent applications of irrigation water are needed because of the moderate available water capacity in some areas. Crop residue on the surface improves organic-matter content and reduces soil blowing. If the soil is calcareous at the surface, phosphate fertilizer is needed, particularly for legumes.

These soils are best suited to corn, grain sorghum, alfalfa and tame grasses. Small grain is not well suited.

CAPABILITY UNIT IIs-2 IRRIGATED

Crete silt loam, 0 to 1 percent slopes, the only soil in this unit, is a deep nearly level soil on uplands. It is moderately well drained. The subsoil is silty clay.

Available water capacity is high. Permeability is slow. This soil absorbs moisture slowly and releases it slowly to plants. Organic-matter content is moderate, and natural fertility is medium to high. The surface layer is easy to work. Runoff is slow.

The compact fine textured subsoil restricts penetration of roots and reduces the movement of air and water. Maintaining ample moisture in the soil throughout the growing season reduces crop stress from moisture shortage. Maintaining a high fertility level and good soil structure and improving permeability in the subsoil are other important management concerns.

All types of irrigation are suited to this soil. Except where sprinkler irrigation is used, some land grading commonly is needed to prepare the soil for irrigation. If the subsoil is exposed during land grading, undercutting and backfilling with at least 6 inches of topsoil is needed. The rate of water application should be adjusted to correspond with the rate of water intake. Crop residue on the surface increases water intake and reduces soil blowing. Controlling irrigation runoff at the end of the field is essential for water conservation.

Corn, grain sorghum, and alfalfa are better suited than most other crops to this soil.

CAPABILITY UNIT IIIe-3 IRRIGATED

This unit consists of deep, gently sloping soils on uplands. These soils are well drained. They are severely eroded. Small gullies are common. Nearly all the original dark colored surface layer has been washed away. The surface layer and subsoil are silty clay loam.

Permeability is moderate or moderately slow. Available water capacity is high. The soils absorb moisture slowly, but release it readily to plants. Organic-matter content and natural fertility are low. The soils are somewhat difficult to work because they have poor tilth. They can be readily penetrated by roots. Runoff is medium to rapid, depending on the amount of vegetative cover.

The hazard of water erosion is severe. Proper and timely water application is needed to reduce runoff and water waste. Improving tilth and fertility and increasing the organic-matter content are the main concerns of management. Terraces, contour irrigation, grassed waterways, and crop residue on the surface aid in reducing erosion and controlling runoff.

Sprinkler irrigation is suitable where mechanical or vegetative conservation practices are applied. The slope makes it difficult to control the water erosion that results from rainfall and the additional water for irrigation. The rate of applying water should be carefully controlled so that it does not exceed the intake rate of the soil. Furrow irrigation and border irrigation are also suitable. Land grading to form contour benches can be used in the more gently sloping areas. Management that reduces or controls irrigation runoff at the ends of fields is generally needed.

These soils are well suited to alfalfa and tame grasses. If erosion is controlled, they are also suited to grain sorghum and corn.

CAPABILITY UNIT IIIe-4 IRRIGATED

This unit consists of deep, gently sloping soils on uplands. These soils are well drained. The surface layer is silt loam, and the subsoil is silty clay loam. Many areas are moderately eroded.

Permeability is moderate or moderately slow. Available water capacity is high. The soils absorb moisture easily and release it readily to plants. Organic-matter content is moderate. Natural fertility is medium to high. The soils are easy to work and are readily penetrated by roots. Runoff is medium to rapid, depending on the amount of vegetative cover.

Erosion is a hazard on these soils. Other important concerns of management are reducing runoff and water waste by proper and timely water application, maintaining a high fertility level, and increasing the organic-matter content. Terraces, contour irrigation, grassed waterways, and the maximum use of crop residue on the surface are needed for erosion control in most areas. Sprinkler irrigation is suitable where mechanical or vegetative conservation practices are used. The gentle slope makes it difficult to control erosion. The rate at which irrigation water is applied should not be higher than the intake rate of the soil. Both furrow and border irrigation are suitable along with contour bench leveling. Controlling and conserving irrigation runoff at the ends of fields is essential for good water conservation.

Alfalfa and tame grasses are well suited. Corn and grain sorghum are suited if erosion is controlled.

CAPABILITY UNIT IIIe-6 IRRIGATED

Hord silt loam, 3 to 6 percent slopes, the only soil in this unit, is a deep, gently sloping soil on stream terraces. It is well drained. The subsoil is silt loam.

Permeability is moderate. Available water capacity is high. The soil absorbs moisture easily and releases it readily to plants. Organic-matter content is moderate. Natural fertility is medium to high. This soil is easy to work and is readily penetrated by roots. Runoff is medium.

The hazard of water erosion is severe. Other concerns of management are maintaining high fertility and controlling runoff. Terraces, contour irrigation, grassed waterways, and maximum use of crop residue on the surface are needed for control of erosion.

The rate of applying irrigation water should be carefully controlled so that it does not exceed the intake rate of the soil. Sprinkler irrigation is suitable where mechanical or vegetative conservation practices are applied. The slope makes it difficult to control water erosion resulting from rainfall and the additional water provided by irrigation. Both furrow and border irrigation are suitable along with contour bench leveling. Controlling and conserving irrigation runoff at the ends of fields is also needed for maximum conservation of water.

This soil is well suited to alfalfa and tame grasses. It is also suited to corn and grain sorghum if erosion is controlled.

CAPABILITY UNIT IIIe-7 IRRIGATED

Geary and Jansen silt loams, 3 to 6 percent slopes, is the only mapping unit in this unit. These are gently sloping soils on uplands. The Geary soil is deep. The Jansen soil is moderately deep over mixed sand and gravel. Both soils are well drained. The subsoil is silty clay loam or clay loam. The underlying material is loam in some areas and mixed sand and gravel in others.

Permeability is generally moderate or moderately slow, but is very rapid in the sand and gravel of the Jansen soil. Available water capacity is high in the deep soil and low in the soil that overlies sand and gravel. Both soils absorb moisture easily and release it readily to plants. Organic-matter content is moderate or moderately low. Natural fertility ranges from low to high. These soils are easy to work and are readily penetrated by roots. Runoff is medium to rapid, depending on the amount of vegetative cover.

Water erosion is the main hazard on these soils. Other important concerns of management are reducing runoff and water waste, maintaining fertility, and increasing the organic-matter content. The soil that is moderately deep over mixed sand and gravel is droughty, particularly in summer. Erosion can be controlled by terraces, contour irrigation, grassed waterways, and the maximum amount of crop residue on the surface.

Sprinkler irrigation is suitable where mechanical or vegetative conservation practices are used. The slope makes it difficult to control water erosion that results from rainfall and the additional water from irrigation. Rates of water application should be carefully controlled; they should be no higher than the intake rate of the soils. Contour bench leveling is not well suited. The underlying sand and gravel in some areas limits the removal of soil material necessary during contour bench leveling. Furrow and borders are not well suited for the same reason.

These soils are best suited to alfalfa and grasses for hay or pasture. Corn and grain sorghum are suited if erosion is controlled.

CAPABILITY UNIT IIIe-11 IRRIGATED

This unit consists of deep, nearly level soils on bottom land. These soils are somewhat excessively drained. The surface layer is fine sandy loam or loamy fine sand, and the underlying material is loamy sand.

Permeability is rapid. Available water capacity is low. The soils absorb moisture easily and release it

readily to plants. Organic-matter content and natural fertility are low. Runoff is slow.

The hazard of soil blowing is severe. Other concerns of management are maintaining a balanced and adequate fertility level and increasing the organic-matter content. Leaching of plant nutrients is common in these soils.

Sprinkler irrigation is best suited to these soils. Furrows and borders can be used if the water is carefully managed. It is necessary to limit the length of field irrigation runs. The rate of water application should be adjusted to prevent the leaching of soil nutrients below the level where plant roots can obtain them. Deep cuts should be avoided during land grading because they can expose the sandy underlying material. Soil blowing can be reduced by maintaining a cover of crop residue or a growing crop.

This soil is better suited to grain sorghum and alfalfa and to tame grasses for hay and pasture than to most other crops.

CAPABILITY UNIT IIIw-2 IRRIGATED

Fillmore silt loam, 0 to 1 percent slopes, is the only soil in this capability unit. It is a deep, nearly level soil in shallow depressions of the uplands. It is poorly drained. The subsoil is silty clay.

Permeability is very slow. Available water capacity is high. The soil absorbs moisture slowly and releases it slowly to plants. Organic-matter content is moderate. Natural fertility is medium. The surface layer is easy to work. The compact claypan subsoil restricts the penetration of roots and reduces the movement of air and water. Runoff is very slow.

Excess water runs off adjacent higher areas and ponds in depressional areas. Maintaining high fertility and improving subsoil permeability are the other concerns of management. Including alfalfa in the cropping system helps to open the subsoil and thus aids in moving water through the soil. Land grading that provides for removal of excess surface water following heavy rains is necessary to prepare this soil for irrigation. The rate at which irrigation water is applied should be no higher than the intake rate of the soil. The slow rate of water intake also makes longer periods of irrigation necessary. Re-use pits can be used to cycle irrigation water back to the field.

This soil is suited to corn, grain sorghum, alfalfa, and grasses.

CAPABILITY UNIT IIIw-8 IRRIGATED

Munjor soils, 0 to 2 percent slopes, the only mapping unit in this unit, are deep, nearly level soils on bottom land. They are moderately well drained. The surface layer is silt loam, loam, or fine sandy loam, and the underlying material is mainly sandy loam, very fine sandy loam, or loamy fine sand.

Permeability is moderately rapid. Available water capacity is moderate. Organic-matter content is moderate. Natural fertility is medium or low. Available phosphate is low. Runoff is slow.

These soils are occasionally flooded. They have a water table at a depth of 4 to 8 feet. Wetness, which is the main hazard, commonly delays tillage in spring. Maintaining a balanced fertility level is an important concern of management.

Furrows and borders are the most common irrigation methods, but sprinklers can also be used. An irrigation system that diverts or intercepts floodwater is needed in many areas. Some areas require drainage ditches, tile drains, or diversions to help lower the water table. Land grading is commonly needed to help distribute water evenly in furrow or border irrigation. The high water intake rate of these soils makes it necessary to limit the length of irrigation runs. Controlling and reducing runoff at the end of the field is essential. The use of phosphate fertilizer generally results in an improved stand of crops, particularly for legumes.

These soils are suited to corn, grain sorghum, and tame grasses. If flooding is controlled, alfalfa and small grain are also suited.

CAPABILITY UNIT IVe-3 IRRIGATED

This unit consists of deep, strongly sloping, severely eroded soils on uplands. These soils are well drained. Nearly all the original dark colored surface layer has been washed away. The surface layer and subsoil are silty clay loam.

Permeability is moderate or moderately slow. Available water capacity is high. The soils absorb moisture slowly and release it slowly to plants. They are somewhat difficult to work because tilth is generally poor. They are readily penetrated by roots. Organic-matter content and natural fertility are low. Runoff is medium to rapid.

The hazard of water erosion is very severe. Proper and timely applications of water are needed to reduce runoff and water waste. Poor soil structure, poor tilth, low fertility, and low organic-matter content are other serious concerns of management. Sprinkler irrigation is suitable. In the more gently sloping areas, contour bench leveling is suitable for furrow and border irrigation. Terraces, contour irrigation, grassed waterways, and crop residue on the surface help to control erosion in irrigated areas.

Water erosion caused by both rainfall and irrigation water is difficult to control on these strongly sloping soils. Irrigation water should be applied at a carefully controlled rate that does not exceed the intake rate of the soil. Returning crop residue to the soil improves tilth and increases the organic-matter content. Management that reduces and controls excessive irrigation water runoff is needed for efficient conservation of water.

These soils are best suited to alfalfa and to tame grasses for hay or pasture. They are suited to corn and grain sorghum if erosion is controlled.

CAPABILITY UNIT IVe-4 IRRIGATED

This unit consists of deep, strongly sloping soils on uplands. The soils are well drained. The surface layer is silt loam, and the subsoil is silty clay loam.

Permeability is moderate or moderately slow. Available water capacity is high. The soils absorb moisture easily and release it readily to plants. Organic-matter content is moderate. Natural fertility is medium to high. The surface layer is easy to work, and the soils

are readily penetrated by roots. Runoff is medium to rapid.

Water erosion is a serious hazard on these soils. The main concerns of management are reducing runoff and water waste by proper and timely water application, maintaining balanced and adequate fertility level, and increasing the organic-matter content. Sprinkler irrigation is satisfactory. Some areas are also suited to furrow or border irrigation. Terraces, contour irrigation, contour bench land grading, grassed waterways, and maximum crop residue on the surface help control erosion in irrigated areas. The application of irrigation water at a rate that does not exceed the intake rate of the soil reduces soil loss. Water management that reduces and controls excess runoff is needed for efficient water conservation.

These soils are best suited to alfalfa and to tame grasses for hay and pasture. They are suited to corn and grain sorghum if erosion is carefully controlled.

CAPABILITY UNIT IVe-7 IRRIGATED

Geary and Jansen soils, 6 to 11 percent slopes, eroded, is the only mapping unit in this unit. They are well drained, strongly sloping soils on uplands. The Geary soil is deep, and the Jansen soil is moderately deep over mixed sand and gravel. The surface layer is silt loam, and the subsoil is silty clay loam.

Permeability is generally moderate or moderately slow, but it is very rapid in the sand and gravel of the Jansen soil. Available water capacity ranges from low in the moderately deep soil to high in the deep soil. Both soils absorb moisture easily and release it readily to plants. Organic-matter content is moderate or moderately low. Natural fertility ranges from low to high. The surface layer is easy to work and is readily penetrated by roots. Runoff is medium to rapid.

Water erosion is the main hazard on these soils. Other management concerns are reducing runoff and water waste by proper and timely water management, maintaining a balanced, adequate fertility level, and increasing the organic-matter content. Moisture storage is limited where the soils are only moderately deep over sand and gravel.

Sprinkler irrigation is satisfactory. Terraces, contour irrigation, grassed waterways, and maximum crop residue on the surface help control runoff and reduce soil loss. The strong slopes make it difficult to control water erosion that results from rainfall and the additional water from irrigation. The rate of water application should be carefully controlled; it should be no higher than the intake rate of these soils. Furrow irrigation and border irrigation are not well suited. The depth to sand and gravel limits the removal of soil material necessary for contour bench leveling. Returning crop residue increases the organic-matter content.

These soils are best suited to alfalfa and grasses for hay and pasture.

Predicted Yields

Predicted yields per acre for the principal crops grown on soils of Nuckolls County are listed in table 2. These predictions are for seeded acres and are based on average yields over the most recent 5-year period.

Information supporting the data in table 2 was obtained from interviews with farmers, directors of the Natural Resource Districts, representatives of the Soil Conservation Service and Agricultural Extension Service, and others familiar with the soils and farming in the county. Yield information from the Agriculture Stabilization and Conservation Service and research data from Agricultural Experiment Stations were also used. Yield records, trends, research, and experience were considered.

Crop yields are influenced by many factors. Some of the most influential soil features are depth, texture, slope, and drainage. Also important are erosion, available water capacity, permeability, and fertility. The cropping system, timely fieldwork, plant population, and crop variety affect crop yields. Also weather is significant, both day-to-day and longer seasonal or yearly fluctuations. All of these factors were taken into account in preparing table 2.

The yields listed are those predicted for a high level of management. Under this level of management, fertility is maintained and fertilizer or lime is applied at rates indicated by soil tests and field experiments. Crop residue is returned to the soil to improve tilth and maintain or increase the organic-matter content. Suitable varieties of seeds are used, and plant populations are optimum. Weeds, insects, and diseases are controlled. Irrigation water is applied at the proper time and in proper amounts. Water erosion and soil blowing are controlled. Where drainage is needed for crop production, the soil is drained. Adequate tillage and seeding are performed at the proper time. The soil is protected from deterioration and used according to its capacity.

Yields in any one year on a particular soil may vary considerably from the figures given. This variation can be caused by the effect of weather, sudden infestations of diseases, insects, or other unpredictable hazards. By using long-time averages, it is possible to consider such hazards in predicting crop yields. Improved technology may make predictions in the table obsolete in a few years.

Range [2]

About 30 percent of the total farm acreage in Nuckolls County is range. It is scattered throughout the county, but is somewhat concentrated in the southwestern part. Range is generally not suitable for cultivation. The major soil associations in range are Geary-Jansen-Meadin and Geary-Holder.

Raising livestock, mainly cow and calf herds, is the second largest farm industry in the county. The calves are sold in fall as feeders. The range is generally grazed from late in spring to early in fall. The livestock graze milo or corn aftermath in fall and are fed hay or silage in winter.

Management that maintains or improves the range condition is needed on all range. Proper grazing use,

[2] Prepared by PETER N. JENSEN, range conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average yields per acre of principal crops*

[Yields are for seeded acres under a high level of management. Dashes indicate that the soil is considered unsuitable for the crop or the crop is not commonly grown on the soil. Only arable soils are listed]

Soil	Corn		Grain sorghum		Wheat	Alfalfa hay	
	Dryland	Irrigated	Dryland	Irrigated	Dryland	Dryland	Irrigated
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*
Butler silt loam, 0 to 1 percent slopes	46	125	64	115	32	3.0	5.8
Cass loam, occasionally flooded, 0 to 2 percent slopes	64	130	73	120	32	3.5	6.0
Cozad silt loam, 0 to 1 percent slopes	66	145	75	125	40	3.5	6.5
Crete silt loam, 0 to 1 percent slopes	48	130	65	115	38	3.0	5.5
Fillmore silt loam, 0 to 1 percent slopes	40	90	55	100	23	1.8	—
Fillmore silt loam, drained, 0 to 1 percent slopes	45	125	64	115	32	3.0	5.8
Geary silt loam, 3 to 6 percent slopes	42	120	55	110	30	2.5	5.5
Geary silt loam, 6 to 11 percent slopes	38	—	43	—	23	2.2	—
Geary silty clay loam, 3 to 6 percent slopes, eroded	39	—	48	—	27	2.2	—
Geary silty clay loam, 6 to 11 percent slopes, eroded	—	—	37	—	20	1.8	—
Geary and Jansen silt loams, 3 to 6 percent slopes	33	—	45	—	25	2.1	5.0
Geary and Jansen soils, 6 to 11 percent slopes, eroded	—	—	30	—	16	1.4	—
Gibbon silt loam, 0 to 1 percent slopes	63	130	75	120	30	4.2	5.5
Hall silt loam, 0 to 1 percent slopes	60	145	75	125	41	3.5	6.5
Hall silt loam, terrace, 0 to 1 percent slopes	63	145	77	125	42	4.2	6.5
Hastings silt loam, 0 to 1 percent slopes	55	145	69	125	40	3.2	6.5
Hastings silt loam, 1 to 3 percent slopes	53	140	66	120	37	3.0	6.2
Hastings silt loam, 3 to 6 percent slopes	46	125	60	115	33	2.7	5.8
Hastings silty clay loam, 3 to 6 percent slopes, eroded	43	115	54	95	30	2.5	5.4
Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes	68	140	75	120	34	4.0	6.0
Holder silt loam, 1 to 3 percent slopes	55	140	68	120	38	3.1	6.2
Holder silt loam, 3 to 6 percent slopes	48	125	62	115	34	2.8	5.8
Holder silt loam, 6 to 11 percent slopes	40	—	50	—	27	2.4	—
Holder silty clay loam, 3 to 6 percent slopes, eroded	45	115	58	95	31	2.6	5.4
Holder silty clay loam, 6 to 11 percent slopes, eroded	34	—	43	—	24	2.0	—
Hord silt loam, 0 to 1 percent slopes	64	145	79	125	43	4.2	6.5
Hord silt loam, 1 to 3 percent slopes	61	140	75	120	41	4.0	6.2
Hord silt loam, 3 to 6 percent slopes	46	125	60	115	33	2.8	5.8
Inavale loamy fine sand, 0 to 2 percent slopes	35	100	30	80	18	2.0	3.8
Inavale fine sandy loam, 0 to 2 percent slopes	40	110	45	90	25	2.4	4.0
McCook fine sandy loam, 0 to 2 percent slopes	62	130	72	115	33	3.6	6.0
McCook silt loam, 0 to 1 percent slopes	69	145	80	125	38	4.0	6.5
Munjor soils, 0 to 2 percent slopes	50	125	65	110	30	2.7	5.5
Scott silt loam, 0 to 1 percent slopes	—	—	28	—	15	—	—
Wann fine sandy loam, 0 to 2 percent slopes	59	125	70	110	29	3.8	5.5
Wann loam, 0 to 2 percent slopes	62	130	72	115	34	4.0	6.0

deferred grazing, and planned grazing systems (fig. 13) are to be considered.

The proper distribution of livestock in a pasture can be improved by proper location of fences, salting facilities, and livestock water developments

Range seeding improves the range condition. This is the establishment by seeding or reseeding of native grasses, either wild harvest or improved strains, on land suitable for use as range.

Range sites and condition classes

Different kinds of range produce different kinds and amounts of native grass. For proper range management, an operator should know the different kinds of land or range sites in his holding and the native plants each site can grow. Management can then be used that will favor the growth of the desired forage plants on each kind of land.

Range sites are distinctive kinds of range that differ from each other in their ability to produce a significantly different kind or proportion of climax, or original, vegetation. A significant difference is one great enough to require some variation in management, such as variation in the stocking rate. Climax vegetation is the combination of plants that originally grew on a given site. The most productive combination of range plants on a site is generally the climax vegetation.

Range condition is classified according to the percent of vegetation on the site that is original, or climax, vegetation. This classification is used for comparing the kind and amount of present vegetation to the kind and amount of vegetation that the site can produce. Changes in range condition are caused mainly by intensity of grazing and by drought.

Climax vegetation can be altered by intensive grazing. Livestock graze selectively. They constantly seek the more palatable and nutritious plants. *Decreasers* are the most heavily grazed and, consequently, the first to be injured by overgrazing. *Increasers* withstand grazing better because they are less palatable to the livestock. They increase under grazing and replace the decreasers. *Invaders* are mainly weeds and other less

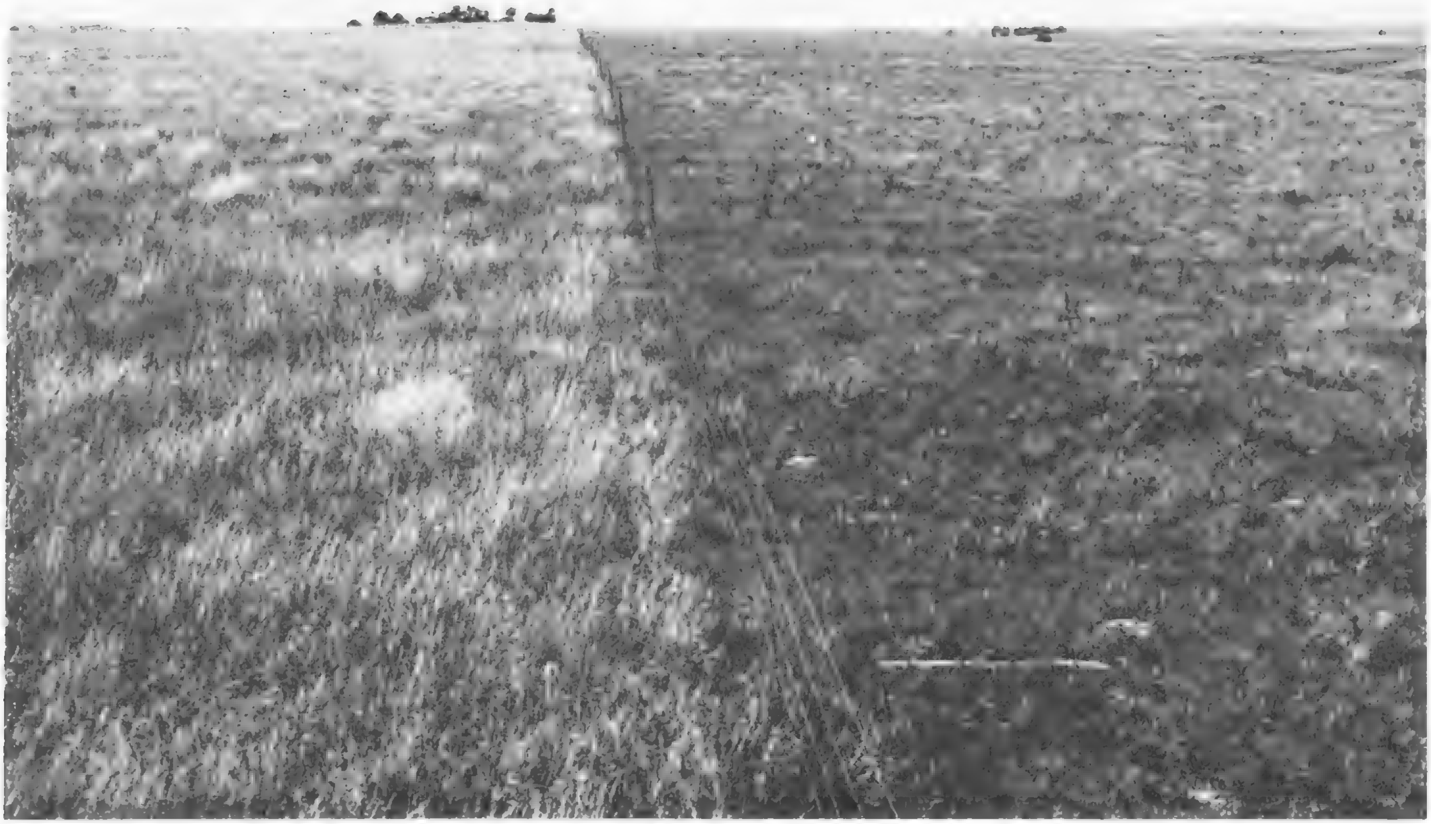


Figure 13.—Suspension fence in pasture on Hastings silt loam, 1 to 3 percent slopes. Pasture can be grazed and rested during the same growing season.

productive, less desirable plants that become established after the climax vegetation has been reduced by grazing.

Range condition is expressed in four condition classes to show the present condition of the vegetation on a range site in relation to the vegetation that grew on it originally. The condition is *excellent* if 76 to 100 percent of the vegetation is climax. It is *good* if the percentage is 60 to 75; *fair* if 26 to 50; and *poor* if 0 to 25 (fig. 14).

Descriptions of range sites

The range sites in Nuckolls County are Subirrigated, Silty Overflow, Silty Lowland, Clayey Overflow, Sandy Lowland, Saline Subirrigated, Silty, Clayey, Shallow Limy, and Shallow to Gravel. All are described on the pages that follow.

To find the names of all the soils in any given site, refer to the "Guide to Mapping Units" at the back of the publication. Likewise, the range site for each soil mapping unit can be determined by referring to "Guide to Mapping Units." Marsh and Sandy alluvial land are not assigned to a range site because they are generally not used for range.

SUBIRRIGATED RANGE SITE

This range site of deep, nearly level, somewhat poorly drained soils is on bottom land. The surface layer and underlying material are medium textured or moderately coarse textured. The soils are generally calcareous at the surface. The kind of vegetation is primarily the result of a fluctuating water table, which is 2 to 5 feet beneath the surface.

Such decreaser grasses as big bluestem, indiangrass, switchgrass, prairie cordgrass, and Canada wildrye make up at least 75 percent of the total climax plant cover. The rest is other perennial grasses and forbs. Kentucky bluegrass, western wheatgrass, and members of the sedge family are the main increasers. If the site is in poor range condition, the typical plant community is Kentucky bluegrass, foxtail barley, dandelion, blue verbena, cottonwood, willows and a sparse amount of western wheatgrass and sedges.

If this site is in excellent range condition, the total annual production of air-dry herbage ranges from 4,500 pounds per acre in unfavorable years to 5,500 pounds in favorable years.

Figure 14.—Range in excellent condition. The most important grasses are little bluestem, big bluestem, side-oats grama, blue grama, and western wheatgrass. The soil is Hastings silt loam, 1 to 3 percent slopes.

SILTY OVERFLOW RANGE SITE

This range site of deep, nearly level soils and land types is on bottom land. It is occasionally flooded. The soils have a medium textured surface layer and medium textured or moderately coarse textured underlying material. The kind of vegetation is primarily the result of additional moisture received as overflow or as runoff from higher lying areas.

Such decreaser grasses as big bluestem, indiangrass, switchgrass, prairie cordgrass, little bluestem, and Canada wildrye make up at least 70 percent of the total climax plant cover. The rest is other grasses and forbs. Kentucky bluegrass, needleandthread, green muhly, and various sedges are the main increasers. If the site is in poor range condition, the typical plant community is Kentucky bluegrass, sedges, common ragweed, and Baldwin ironweed.

If this site is in excellent range condition, the total annual production of air-dry herbage ranges from 4,000 pounds per acre in unfavorable years and 5,000 pounds in favorable years.

SILTY LOWLAND RANGE SITE

This range site of deep, nearly level soils is on bottom land and stream terraces. These soils are well drained or moderately well drained. The surface layer and subsoil are medium textured. Runoff is low or medium. The kind of vegetation is primarily a result of the additional moisture received as runoff from areas of higher lying soils.

Such decreaser grasses as big bluestem, indiangrass, switchgrass, little bluestem, and Canada wildrye make up at least 65 percent of the total climax plant cover. The rest is other grasses and forbs. Kentucky bluegrass, needleandthread, green muhly, tall dropseed, and various sedges are the main increasers. If the site is in poor range condition, the typical plant community is Kentucky bluegrass, common ragweed, and sedges.

If this site is in excellent range condition, the total annual production of air-dry herbage ranges from 3,500 pounds per acre in unfavorable years to 5,000 pounds in favorable years.

CLAYEY OVERFLOW RANGE SITE

The only soil in this range site is Fillmore silt loam, 0 to 1 percent slopes. It is a deep, nearly level soil in depressions of the upland. The surface layer is medium textured, and the subsoil is fine textured. This soil is somewhat droughty because of restricted movement of water and restricted growth of roots in the claypan. Runoff is slow or ponded. The kind of vegetation is primarily the result of additional moisture received from adjacent higher lying areas and the ponding after rains.

Such decreaser grasses as big bluestem, switchgrass, prairie cordgrass, indiangrass, little bluestem, and Canada wildrye make up at least 65 percent of the total climax plant cover. The rest is other grasses and forbs. Kentucky bluegrass and various sedges are the main increasers. If the site is in poor range condition, the typical plant community is Kentucky bluegrass, common ragweed, Baldwin ironweed, and sedges.

If this site is in excellent range condition, the total annual production of air-dry herbage ranges from 3,000 pounds per acre in unfavorable years to 4,500 pounds in favorable years.

SANDY LOWLAND RANGE SITE

This range site of deep, nearly level, well drained or somewhat excessively drained soils is on bottom land. The surface layer is medium textured to coarse textured, and the underlying material is moderately coarse textured or coarse textured. The kind of vegetation is primarily a result of the influence of periodic overflow or a water table that is 3 to 8 feet beneath the surface.

Such decreaser grasses as big bluestem, little bluestem, switchgrass, needleandthread, indiangrass, and Canada wildrye make up at least 75 percent of the total climax plant cover. The rest is other perennial grasses and forbs. Blue grama, sand dropseed, Scribner panicum, western wheatgrass, and sedges are the main increasers. If the site is in poor range condition, the typical plant community is sand dropseed, Scribner panicum, blue grama, western ragweed, and sedges.

If this site is in excellent range condition, the total annual production of air-dry herbage ranges from 3,000 pounds per acre in unfavorable years to 4,000 pounds in favorable years.

SALINE SUBIRRIGATED RANGE SITE

This range site consists of Saline-alkali land. It is poorly drained, nearly level soil material on bottom land. It is strongly alkaline and very strongly alkaline in the upper 24 inches. The water table fluctuates from near the surface to a depth of 2 feet. About 60 percent of Saline-alkali land is moderately coarse material, and the rest is moderately fine textured. The vegetation that grows on this site is primarily a result of the very strong alkalinity and the high water table.

Such decreaser grasses as western wheatgrass, switchgrass, indiangrass, and Canada wildrye make up at least 45 percent of the total climax plant cover. The rest is other perennial grasses and forbs. Inland saltgrass, blue grama, buffalograss, Kentucky bluegrass, and members of the sedge family are the main increasers. If the site is in poor range condition, the typical plant community is blue grama, buffalograss, tumblegrass, windmillgrass, annual brome, Kentucky bluegrass and sedges.

If this site is in excellent condition, the total annual production of air-dry herbage ranges from 2,500 pounds per acre in unfavorable years to 4,000 pounds in favorable years.

SILTY RANGE SITE

This range site of deep and moderately deep, well drained, nearly level to steep soils is on uplands. Runoff ranges from slow on nearly level soils to rapid on the steep soils. The surface layer and subsoil are medium textured or moderately fine textured, and the underlying material is moderately fine textured to very coarse textured. Some areas are eroded, and others are severely eroded. The kind of vegetation is primarily a result of the influence of texture of the surface layer.

Such decreaser grasses as big bluestem, little bluestem, indiangrass, and switchgrass make up at least 65 percent of the total climax plant cover. The rest is other perennial grasses, forbs, and shrubs. Side-oats grama, blue grama, tall dropseed, western wheatgrass, Scribner panicum, and various sedges are the principal increasers. If the site is in poor range condition, the typical plant community is blue grama, buffalograss, sand dropseed, prairie three-awn, Scribner panicum, and western ragweed.

If this site is in excellent range condition, the total annual production of air-dry herbage ranges from 3,000 pounds per acre in unfavorable years to 4,000 pounds in favorable years.

CLAYEY RANGE SITE

This range site of deep, nearly level soils is on uplands or in depressions of uplands. These soils are somewhat droughty because of the restricted movement of water and roots in the claypan subsoil. The surface layer is medium textured, and the subsoil is fine textured. Runoff is slow. Some areas receive additional moisture from higher, adjacent areas. The kind of vegetation is primarily a result of the influence of the slow permeability in the subsoil.

Such decreaser grasses as big bluestem, little bluestem, switchgrass, indiangrass, prairie dropseed, and Canada wildrye make up at least 60 percent of the total climax plant cover. The rest is other perennial grasses, forbs, and shrubs. Side-oats grama, blue grama, tall dropseed, Scribner panicum, western wheatgrass and various sedges are the main increasers. If the site is in poor range condition, the typical plant community is blue grama, buffalograss, sand dropseed, Kentucky bluegrass, and western ragweed.

If this site is in excellent range condition, the total annual production of air-dry herbage ranges from 1,500 pounds per acre in unfavorable years to 3,500 pounds in favorable years.

SHALLOW LIMY RANGE SITE

The only soil in this range site is Kipson silt loam, 6 to 30 percent slopes. It is a shallow, droughty soil on uplands. It is only 10 to 20 inches deep over limestone. It is calcareous at the surface. The kind of vegetation is primarily a result of low available water capacity. Runoff is medium to rapid.

Such decreaser grasses as little bluestem, big bluestem, side-oats grama, indiangrass, plains muhly, and prairie junegrass make up at least 70 percent of the total climax plant cover. The rest is other perennial grasses, forbs, and shrubs. Blue grama, hairy grama, buffalograss, sand dropseed, and sedges are the main increasers. This site rarely is in poor range condition because it is inaccessible to livestock.

If this site is in excellent range condition, the total annual production of air-dry herbage ranges from 1,500 pounds per acre in unfavorable years to 3,000 pounds in favorable years.

SHALLOW TO GRAVEL RANGE SITE

The only soil in this range site is Meadin loam, 6 to 30 percent slopes. It is shallow over mixed sand and gravel and is on uplands. Runoff is medium to rapid. The soil is droughty. The kind of vegetation is primarily a result of the low available water capacity.

Such decreaser grasses as little bluestem, sand bluestem, switchgrass, prairie junegrass, and needleandthread make up at least 65 percent of the total climax plant cover. The rest is other perennial grasses and forbs. Blue grama, hairy grama, western wheatgrass, sand dropseed, Scribner panicum, and sedges are the main increasers. If the site is in poor range condition, the typical plant community is blue grama, hairy grama, sand dropseed, prairie three-awn, purple lovegrass, curlycup gumweed, health aster, western ragweed, and common pricklypear.

If this site is in excellent range condition, the total annual production of air-dry herbage ranges from 1,000 pounds per acre in unfavorable years to 2,500 pounds in favorable years.

Following are the scientific and common plant names mentioned in the descriptions of the range sites:

Common name	*Scientific name*
Annual bromes	*Bromus spp. L.*
Baldwin ironweed	*Veronia baldwini Torr.*
Big bluestem	*Andropogon gerardi Vitman*
Blue grama	*Bouteloua gracilis (H.B.K.) Lag. ex Stend.*
Blue verbena	*Verbena hastata L.*
Buffalograss	*Buchloe dactyloides (Nutt.) Engelm.*
Canada wildrye	*Elymus canadensis L.*
Common pricklypear	*Opuntia compressa (Salisb.) Macbr.*
Common ragweed	*Ambrosia artemisiifolia L.*
Cottonwood	*Populus deltoides var. occidentalis Rydb.*
Curlycup gumweed	*Grindelia squarrosa (Pursh) Dunal*
Dandelion	*Taraxacum officinale Weber in Wiggers*
Foxtail barley	*Hordeum jubatum L.*
Green muhly	*Muhlenbergia racemosa (Michx.) B.S.P.*
Hairy grama	*Bouteloua hirsuta Lag.*
Heath aster	*Aster ericoides L.*
Indiangrass	*Sorghastrum nutans (L.) Nash*
Inland saltgrass	*Distichlis stricta (Torn) Rydb.*
Kentucky bluegrass	*Poa pratensis L.*
Little bluestem	*Andropogon scoparius Michx.*
Needleandthread	*Stipa comata Trin. and Rupr.*
Plains muhly	*Muhlenbergia cuspidata (Torr.) Rydb.*
Prairie cordgrass	*Spartina pectinata Link*
Prairie dropseed	*Sporobolus heterolepis (A. Gray) A. Gray*
Prairie junegrass	*Koeleria cristata (L.) Pers.*
Prairie three-awn	*Aristida oligantha Michx.*
Purple lovegrass	*Eragrostis spectabilis (Pursh) Stend.*
Sand bluestem	*Andropogon hallii Hack.*
Sand dropseed	*Sporobolus cryptandrus (Torr.) A. Gray*
Scribner panicum	*Panicum scribnerianum Nash*
Sedges	*Carex spp. L.*
Side-oats grama	*Bouteloua curtipendula (Michx.) Torr.*
Switchgrass	*Panicum virgatum L.*
Tall dropseed	*Sporobolus asper (Michx.) Kunth*
Tumblegrass	*Schedonnardus paniculatus (Nutt.)*
Western ragweed	*Ambrosia psilostachya DC.*
Western wheatgrass	*Agropyron smithii Rydb.*
Windmillgrass	*Chloris verticillata Nutt.*
Willows	*Salix spp L.*

Windbreaks [3]

Native woodland in Nuckolls County is limited to somewhat narrow strips along the larger streams. The most extensive stands grow on bottom land in the Republican River Valley. These stands are mostly cottonwood and an understory of boxelder and willow. Other stands along the Little Blue River and its tributaries are mainly American elm, boxelder, green ash, hackberry, willows, black walnut, bur oak, eastern cottonwood, and woody shrubs. The stands of native woodland in Nuckolls County are mainly on silty alluvial land.

Early settlers in Nuckolls County planted trees for protection, shade, and fence posts. Through the years landowners have continued to plant trees to protect their buildings and livestock. Native trees and shrubs contribute to the natural beauty of the landscape of Nuckolls County and produce food and cover for wildlife.

Because of the scarcity of many trees and the severe weather, windbreaks are needed for farmstead and livestock protection. Windbreaks help reduce home heating costs, control snow drifting, reduce soil erosion, provide shelter for livestock, improve habitat for wildlife, and beautify the home and countryside.

Narrow windbreaks or screen plantings are also useful in urban areas where they slow down windspeed, settle the dust, and help to reduce the noise level.

Although trees are not easily established every year in Nuckolls County, the observance of basic rules of tree culture can result in a high degree of tree survival. Healthy seedlings of suited species, maintained in good condition, and properly planted in a well prepared site can survive and grow well. They require care after planting if they are to continue to survive.

Table 3 shows the expected height at age 20 years of trees suitable for windbreaks in this county. Detailed measurements were taken for most tree and shrub species listed in this table. Some tree heights and suitability ratings, however, were estimated. The measurements were taken by forestry technicians in windbreaks about 20 years old. The soils were then grouped into seven windbreak suitability groups. The soils in each group are similar in characteristics that affect the growth of trees.

[3] Prepared by JAMES W. CARR, JR., forester, Soil Conservation Service.

Table 3.—*Windbreak plantings*

[No height is listed if species is poorly suited. No data are listed for windbreak groups 5 and 10. The only soil in group 5 is the Jansen soil in mapping units GgC and GhD2. The soils in group 10 are generally not suited to windbreaks]

Windbreak group	Conifer trees			Broadleaf trees			Shrubs		
	Species	Suitability	Height in 20 years	Species	Suitability	Height in 20 years	Species	Suitability	Height in 20 years
			Feet			*Feet*			*Feet*
Group 1: Ca, Co, Hb, Hf, Hr, HrB, Mc.	Austrian pine	Good	32	American sycamore	Good	34	American plum	Good	8
	Black Hills spruce	Good	25	Black walnut	Good	26	Amur honeysuckle	Good	10
	Blue spruce	Good	25	Bur oak	Good	24	Amur maple	Good	14
	Eastern redcedar	Good	24	Eastern cottonwood	Fair	54	Autumn-olive	Good	12
	Ponderosa pine	Good	32	Golden willow	Fair	30	Common chokecherry	Good	12
	Scotch pine	Good	30	Green ash	Good	28	Hansen rose	Good	6
				Hackberry	Good	27	Lilac	Good	8
				Honeylocust	Good	32	Nanking cherry	Poor	---
				Red-osier dogwood	Fair	8	Peking cotoneaster	Good	8
				Skunkbush sumac	Good	10	Tatarian honeysuckle	Fair	8
				Winterberry euonymus	Good	14			
				Midwest Manchurian crabapple.	Fair	18			
				Russian mulberry	Good	26			
				Russian-olive	Fair[1]	20			
				Silver maple	Good	30			
Group 2: Bu, Fo, Gn, Wb, Wm.	Austrian pine	Good	25	American sycamore	Good	32	American plum	Fair	6
	Black Hills spruce	Fair	20	Black walnut	Poor	---	Amur honeysuckle	Fair	8
	Blue spruce	Poor	---	Bur oak	Poor	---	Amur maple	Fair	8
	Eastern redcedar	Good	22	Eastern cottonwood	Fair	50	Autumn-olive	Fair	10
	Ponderosa pine	Poor	---	Golden willow	Good	30	Common chokecherry	Good	8
	Scotch pine	Good	24	Green ash	Fair	26	Hansen rose	Poor	---
				Hackberry	Fair	24	Lilac	Fair	8
				Honeylocust	Fair	32	Nanking cherry	Poor	---
				Red-osier dogwood	Good	8	Peking cotoneaster	Poor	---
				Skunkbush sumac	Poor	---	Tatarian honeysuckle	Fair	6
				Winterberry euonymus	Poor	---			
				Midwest Manchurian crabapple.	Poor	---			
				Russian mulberry	Good	26			
				Russian-olive	Poor	---			
				Silver maple	Good	34			
Group 3: Ig, In, Mb, Mu	Austrian pine	Good	30	American sycamore	Fair	28	American plum	Good	6
	Black Hills spruce	Fair	22	Black walnut	Fair	24	Amur honeysuckle	Good	8
	Blue spruce	Fair	22	Bur oak	Fair	24	Amur maple	Fair	8
	Eastern redcedar	Good	22	Eastern cottonwood	Fair	55	Autumn-olive	Fair	10
	Ponderosa pine	Good	30	Golden willow	Poor	---	Common chokecherry	Good	8
	Scotch pine	Good	30	Green ash	Fair	27	Hansen rose	Good	7
				Hackberry	Fair	26	Lilac	Good	7
				Honeylocust	Fair	30	Nanking cherry	Poor	---
				Red-osier dogwood	Poor	---	Peking cotoneaster	Fair	6
				Skunkbush sumac	Good	8	Tatarian honeysuckle	Good	7
				Winterberry euonymus	Fair	12			
				Midwest Manchurian crabapple.	Fair	14			
				Russian mulberry	Fair	22			
				Russian-olive	Fair[1]	18			
				Silver maple	Fair	26			
Group 4: Cr, GaC, GaD, GeC2, GeD2, GgC, GhD2, Ha, Hc, HcB, HcC, HdC2, HgB, HgC, HgD, HhC2, HhD2, HrC.	Austrian pine	Good	26	American sycamore	Poor	---	American plum	Fair	6
	Black Hills spruce	Poor	---	Black walnut	Poor	---	Amur honeysuckle	Good	8
	Blue spruce	Fair	23	Bur oak	Good	22	Amur maple	Good	10
	Eastern redcedar	Good	24	Eastern cottonwood	Poor	---	Autumn-olive	Good	10
	Ponderosa pine	Good	27	Golden willow	Poor	---	Common chokecherry	Good	10
	Scotch pine	Good	26	Green ash	Good	26	Hansen rose	Good	6
				Hackberry	Good	24	Lilac	Good	8
				Honeylocust	Good	26	Nanking cherry	Poor	---
				Red-osier dogwood	Poor	---	Peking cotoneaster	Good	6
				Skunkbush sumac	Good	8	Tatarian honeysuckle	Fair	7
				Winterberry euonymus	Good	12			

See footnote at end of table.

TABLE 3.—*Windbreak plantings*—Continued

Windbreak group	Conifer trees			Broadleaf trees			Shrubs		
	Species	Suitability	Height in 20 years	Species	Suitability	Height in 20 years	Species	Suitability	Height in 20 years
			Feet			*Feet*			*Feet*
				Midwest Manchurian crabapple.	Poor	------			
				Russian mulberry	Good	22			
				Russian-olive	Fair	19			
				Silver maple	Fair	24			
Group 6: Fm	Austrian pine	Poor	------	American sycamore	Poor	------	American plum	Poor	------
	Black Hills spruce	Poor	------	Black walnut	Poor	------	Amur honeysuckle	Poor	------
	Blue spruce	Poor	------	Bur oak	Poor	------	Amur maple	Poor	------
	Eastern redcedar	Poor	------	Eastern cottonwood	Fair	45	Autumn-olive	Poor	------
	Ponderosa pine	Poor	------	Golden willow	Good	26	Common chokecherry	Poor	------
	Scotch pine	Poor	------	Green ash	Poor	------	Hansen rose	Poor	------
				Hackberry	Poor	------	Lilac	Poor	------
				Honeylocust	Poor	------	Nanking cherry	Poor	------
				Red-osier dogwood	Fair	6	Peking cotoneaster	Poor	------
				Skunkbush sumac	Poor	------	Tatarian honeysuckle	Poor	------
				Winterberry euonymus	Poor	------			
				Midwest Manchurian crabapple.	Poor	------			
				Russian mulberry	Poor	------			
				Russian-olive	Poor	------			
				Silver maple	Poor	------			

[1] Russian-olive should not be planted on soils that are flooded because the species spreads rapidly in these areas.

The suitability ratings given in table 3 are based on observations of the general vigor and condition of the trees in the windbreak. Those species that have a rating of good are best suited to the soils of the specified windbreak group.

A rating of *good* indicates that the following conditions generally apply. Leaves or needles are normal in color and growth. Only a small amount of dead wood (tops, branches, and twigs) occurs in the live crown. Evidence of disease, insect, and climatic damage is limited.

A rating of *fair* indicates that one or more of the following conditions generally apply. Leaves or needles are obviously abnormal in color and growth. A substantial amount of dead wood occurs within the live crown. Evidence of moderate disease, insect, and climatic damage is obvious. Current year's growth is obviously less than normal.

A rating of *poor* indicates that one or more of the following conditions apply. Leaves or needles are very abnormal in color and growth. A very large amount of dead wood occurs within the live crown. Evidence of extensive disease, insect, and climatic damage is obvious.

The conifers cedar and pine seem best suited to use in windbreaks. Measurements show that eastern redcedar, ponderosa pine, Austrian pine, and Scotch pine are the most reliable species for windbreaks. All are rated high in survival and vigor. These species hold their leaves through the winter, thus giving maximum protection when it is most needed. Table 3 also indicates several broadleaf species that are well suited to use in windbreaks in Nuckolls County.

Eastern redcedar can reach a height of 25 to 35 feet at maturity, depending upon the kind of soil. Ponderosa pine, Austrian pine, and Scotch pine and the broadleaf species grow at a slightly faster rate and are somewhat taller at maturity.

Rate of growth in a windbreak varies widely, depending on soil moisture and soil fertility. Exposure and arrangement of trees within the stand also have a marked effect on tree growth. Some species grow faster than others. Some grow fast early, but tend to die young. Occasionally, eastern cottonwood is an example. Siberian elm and Russian-olive are vigorous early growers. They can, however, spread into areas where they are not wanted and be short lived. Boxelder and Russian mulberry commonly freeze back during severe winters. Green ash is susceptible to damage by borers.

A good windbreak should be designed according to the soil in which it is to grow. The intended purpose of the planting should be considered. Specific information on design, establishment, and care of windbreaks is available from the Soil Conservation Service or the Extension Service forester serving Nuckolls County.

Windbreak suitability groups

Soils of Nuckolls County are grouped according to characteristics that affect tree growth. To find the names of all the soils in a group, refer to the Guide to Mapping Units at the back of this survey. Soils in a group produce similar growth and survival under similar weather conditions and care.

Soils of Nebraska are grouped into windbreak suitability groups according to a system that is used statewide. Not all groups are represented in Nuckolls

County. The following paragraphs briefly describe the windbreak suitability groups in Nuckolls County.

WINDBREAK SUITABILITY GROUP 1

This group consists of deep, nearly level to very gently sloping soils on bottom land, stream terraces, and foot slopes. These soils are moderately well drained or well drained. The surface layer is medium textured, and the underlying material is medium textured or moderately fine textured. The soils receive additional moisture as runoff from higher lying areas. Available water capacity is high or moderate.

These soils generally provide good tree planting sites that have good capability for survival and good growth of suited species. Moisture competition from weeds and grasses is the main hazard.

WINDBREAK SUITABILITY GROUP 2

This group consists of deep, nearly level soils on bottom land, drained upland depressions, and in upland basins. These soils are somewhat poorly drained or poorly drained. The surface layer is medium textured to moderately coarse textured. The depressional and upland soils have a fine textured subsoil. The underlying material ranges from fine textured to coarse textured. The soils receive additional moisture from runoff or are moderately wet at times because of a moderately high water table. Available water capacity is moderate or high.

These soils generally provide good tree planting sites that have good capability for survival and growth if the species selected are those that tolerate occasional wetness. Establishment of tree seedlings can be a problem in wet years. Abundant and persistent herbaceous vegetation that grows on these sites is a concern in the establishment and maintenance of trees.

WINDBREAK SUITABILITY GROUP 3

This group consists of deep, nearly level soils. These soils are well drained, moderately well drained, or somewhat excessively drained. The surface layer is moderately coarse textured or coarse textured, and the underlying material is medium textured, moderately coarse textured, or coarse textured. Available water capacity is low to high. Runoff is slow because most of the moisture is readily absorbed by the soils.

These soils provide good tree planting sites that have fair capability for survival and fair growth of suited species. Lack of adequate moisture and soil blowing are the main hazards. Soil blowing can be prevented by maintaining strips of sod or other vegetation between the rows. Cultivation generally should be restricted to the tree rows.

WINDBREAK SUITABILITY GROUP 4

This group consists of deep, nearly level to steep soils on uplands and stream terraces. These soils are well drained or moderately well drained. The surface layer is medium textured or moderately fine textured, and the subsoil is medium textured to fine textured. The underlying material is moderately fine textured to very coarse textured. Available water capacity is high. Runoff is slow to rapid.

These soils generally provide good tree planting sites that have good capability for survival and fair growth of suited species. Drought and moisture competition from weeds and grasses are the main hazards. Water erosion is a hazard in the gently sloping to steep areas. Lack of sufficient moisture reduces growth of trees in the steeper areas where runoff is rapid.

WINDBREAK SUITABILITY GROUP 5

This group consists of gently sloping to strongly sloping soils on uplands. These soils are moderately deep over mixed sand and gravel. They are well drained. The surface layer is medium textured, and the subsoil is medium textured in the upper part and moderately fine textured in the lower part. The underlying material, at a depth of about 24 inches, is very coarse textured sand and gravel. Available water capacity is moderate. Runoff is medium or rapid.

These soils provide fair to poor tree planting sites that have fair capability for survival and fair growth of suited species. The lack of adequate moisture caused by the gravelly underlying material is the main hazard.

WINDBREAK SUITABILITY GROUP 6

The only soil in this group is Fillmore silt loam, 0 to 1 percent slopes. This poorly drained soil is in occasionally flooded depressions of the upland. It receives additional water as runoff from adjacent higher lying areas. The surface layer is medium textured, the subsoil is fine textured, and the underlying material is medium textured. Permeability is very slow, and available water capacity is high.

This soil generally provides poor tree planting sites, but capability for survival and growth of suited species is fair. Excessive wetness is the main hazard. Only those trees and shrubs that can tolerate occasional flooding are suited.

WINDBREAK SUITABILITY GROUP 10

This group consists of soils and land types that have a wide range of slope, texture, depth, wetness, and topography. Soils of this group are too shallow, too erosive, too gravelly, too rocky, or too steep for planting trees with machinery. In places they are too droughty, too wet, or too saline for good survival and growth of tree and shrub plantings.

Soils of this group are generally not suited to windbreak plantings of any kind. Some areas can be used for recreation, forestation, and wildlife plantings of tolerant trees and shrubs that are hand planted or specially managed.

Wildlife [4]

The wildlife population in Nuckolls County is determined largely by the quality and quantity of vegetation that the soil is capable of producing. Cover, food, and water, in proper combination, are the three essential elements to wildlife abundance.

[4] Prepared by ROBERT O. KOERNER, biologist, Soil Conservation Service.

Topography and soil characteristics largely determine the number of wildlife. Fertile soils produce more and better quality wildlife, both game and nongame species. The game species mainly are considered in this section. Nongame species, however, are becoming increasingly important.

In many areas the soils rated highest for wildlife potential do not have the most wildlife. Hunting, clean tillage, and improved harvesting methods and other factors reduce the number of wildlife. The potential remains, and wildlife values can be enhanced with little effort. Wildlife has a place in both rural and urban settings and should be considered in planning for optimum use of these areas.

Fish ponds that fill with runoff from fertile fields generally produce more pounds of fish than average because of the increased food production. Zooplankton are microscopic animals and phytoplankton are microscopic plants produced in fertile ponds. They provide food for the larger aquatic animals such as frogs, which, in turn, are used as food by fish.

Steep slopes and rough, irregular topography are hazards to livestock and are poorly suited to crops. In these areas, the natural undisturbed landscape can provide escape cover for wildlife and a source of food. In many areas where vegetation is lacking, it can be developed by planting flowering and fruiting trees and shrubs.

Wetness, permeability, and available water capacity are important soil characteristics to consider when selecting pond sites for wildlife.

The soil associations, as shown on the general soil map, are evaluated for wildlife habitat potential in Nuckolls County. Table 4 shows the suitability of each for seven wildlife habitat elements and three kinds of wildlife habitat. Suitability is expressed as good, fair, poor, and very poor.

Good indicates that habitat is easily improved, maintained, or created. There are few or no soil limitations, and satisfactory results can be expected.

Fair indicates that habitat can be improved, maintained, or created, but moderate soil limitations affect habitat management. A moderate intensity of management and fairly frequent attention may be required to insure satisfactory results.

Poor indicates that habitat can be improved, maintained, or created, but soil limitations are severe. Management may be difficult and expensive and require intensive effort. Results are questionable.

Very poor indicates that under the prevailing soil conditions, it is impractical to attempt to improve, maintain, or create habitat. Unsatisfactory results are probable.

The seven habitat elements are described in the following paragraphs.

Grain and seed crops are domestic grain or other seed-producing annuals planted to produce wildlife

TABLE 4.—*Potential of soils, by soil associations, for wildlife habitat*

Soil association	Habitat elements							Kinds of habitat		
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees and shrubs	Coniferous plants	Wetland food and cover	Shallow water areas	Openland	Woodland	Wetland
Hastings:										
Hastings	Good	Good	Good	Fair	Fair	Very poor	Very poor	Good	Fair	Very poor.
Geary-Hastings:										
Geary	Fair	Good	Good	Fair	Good	Very poor	Very poor	Good	Fair	Very poor.
Hastings	Fair	Good	Good	Fair	Fair	Very poor	Very poor	Good	Fair	Very poor.
Geary-Holder:										
Geary	Fair	Good	Good	Fair	Good	Very poor	Very poor	Good	Fair	Very poor.
Holder	Fair	Good	Good	Fair	Good	Very poor	Very poor	Good	Fair	Very poor.
Crete-Hastings:										
Crete	Good	Good	Fair	Fair	Fair	Very poor	Poor	Good	Fair	Very poor.
Hastings	Good	Good	Good	Fair	Fair	Very poor	Very poor	Good	Fair	Very poor.
Geary-Jansen-Meadin:										
Geary	Fair	Good	Good	Fair	Good	Very poor	Very poor	Good	Fair	Very poor.
Jansen	Fair	Good	Good	Poor	Fair	Very poor	Very poor	Good	Poor	Very poor.
Meadin	Very poor	Poor	Poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor.
Hord:										
Hord	Good	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Hord-Cass-Hobbs:										
Hord	Good	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Cass	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor.
Hobbs	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
McCook-Wann-Inavale:										
McCook	Good	Good	Good	Fair	Fair	Very poor	Very poor	Good	Fair	Very poor.
Wann	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
Inavale	Fair	Good	Good	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.

food. Examples are corn, sorghum, wheat, oats, barley, millet, soybeans, and sunflowers.

Domestic grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife cover and food. Examples are fescue, bluegrass, bromegrass, timothy, orchardgrass, clover, alfalfa, trefoil, and crownvetch.

Wild herbaceous plants are native or naturally established dryland herbaceous grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestem, indiangrass, goldenrod, beggarweed, partridgepea, pokeweed, wheatgrass, fescue, and grama.

Hardwood trees and shrubs are nonconiferous trees and associated wood understory plants that provide wildlife cover or that produce nuts, buds, catkins, twigs, bark, or foliage used as food by wildlife. The shrubs produce buds, twigs, bark, or foliage used as food by wildlife, and provide cover and shade for some wildlife species. Examples are snowberry, honeysuckle, and Russian-olive.

Coniferous plants are cone-bearing trees, shrubs, and ground cover that furnish wildlife cover or supply food in the form of browse, seeds, or fruitlike cones. They are commonly established naturally, but may be planted or transplanted. Examples are pine, spruce, fir, cedar, and juniper.

Wetland food and cover is annual and perennial wild herbaceous plants on moist to wet sites, exclusive of submerged or floating aquatics, that produce food or cover used extensively by wetland wildlife. Examples are smartweed, wild millet, rushes, sedges, reeds, cordgrass, and cattail.

Shallow water areas are areas of surface water, having an average depth of less than 5 feet, that are useful to wildlife. They may be natural wet areas or those created by dams or levees or by water-control devices in marshes or streams. Examples are muskrat marshes, waterfowl feeding areas, wildlife watering developments, wildlife ponds, and beaver ponds.

The three kinds of habitat are openland, woodland, and wetland habitat. They are directly related to three broad classes of wildlife.

Openland wildlife are birds and mammals of cropland, pastures, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines. Examples are bobwhite quail, pheasant, meadowlark, killdeer, cottontail rabbit, red fox, and woodchuck.

Woodland wildlife are birds and mammals in wooded areas of either hardwood or coniferous trees and shrubs, or a mixture of both. Examples are wild turkey, ruffed grouse, thrushes, vireos, woodpecker, squirrel, gray fox, raccoon, and white-tailed deer.

Wetland wildlife are birds and mammals of swampy, marshy, or open water areas. Examples are ducks, geese, herons, shore birds, rails, kingfishers, muskrat, mink, and beaver.

The Hastings association has nearly level to gently sloping topography, and most of the acreage is in cultivated crops. Openland wildlife are most common. Many attractive farmstead windbreaks are on this association. Many are planted to redcedar, which furnishes good winter protection for wildlife. Deer are scarce, averaging less than one per square mile. About 95 percent is white-tail deer, and 5 percent is mule deer. Along some of the intermittent drainageways, where woody and herbaceous cover is common, the deer population is higher, about four to eight per square mile. A larger number are found in the northern third of the association. Bobwhite quail and cottontail rabbit are in areas where woody and herbaceous cover is close to cultivated areas.

The Geary-Hastings association is about 40 to 50 percent grassland, and the rest is mainly in cultivated dryland crops. It is an area where openland wildlife are most common. Deer use this association for escape. Pheasants and quail use it for nesting cover. The grassy draws provide travel lanes for wildlife to move to areas of cultivated crops where food is obtained. The drainageways also provide good sites for farm ponds. Coyote, fox, and other predators extensively use this association for food and water.

The Geary-Holder association is used mainly by openland wildlife. It has several drainageways, including Dry Creek, Oak Creek, Gimlet Creek, and Crooked Auger Creek. Woody and herbaceous plants along these creeks provide cover for a variety of wildlife species, including bobwhite quail, pheasant, songbirds, and small mammals. Crops grown in the less steep areas provide food for the wildlife.

The Crete-Hastings association is used mainly by openland wildlife. Populations of pheasant and quail are high, ranging from 10 to 100 per square mile. Many species of wildlife use this association for food because of the certainty of good crop yields brought about largely by irrigation. This association is the main irrigated area of the county. It provides good habitat for migrating waterfowl because of water that is retained in shallow depressions.

The Geary-Jansen-Meadin association offers little habitat for the common wildlife species because many soils in the association are shallow and good perennial cover is lacking.

The Hord association on stream terraces is used mainly by openland wildlife. It also provides food for wildlife on the adjacent Hord-Cass-Hobbs association and the McCook-Wann-Inavale association where many woodland species of wildlife have their habitat. Habitat is excellent for the openland wildlife along canals that supply irrigation water. Willow thickets are along some drainageways.

The Hord-Cass-Hobbs association, along the Little Blue River and other creek bottoms, provides habitat for woodland wildlife, including deer, squirrel, fox, coyote, raccoon, oppossum, mink, hawks, owls, and numerous species of songbirds. Small marshy areas along the streams provide excellent habitat for muskrat, mink, and shore birds.

The McCook-Wann-Inavale association, along the Republican River, is mainly used by woodland wildlife. It has a high population and wide variety of wildlife species because of the width of the area, the heavy woody cover, and the permanent water supply in the river channel. Small areas of Marsh along the river provide habitat for wetland wildlife, such as muskrats, mink, and shore birds.

Resources for Recreation

An important form of recreation in Nuckolls County is hunting pheasant, quail, and deer.

The streams in Nuckolls County are only fair for fishing. The Republican and Little Blue Rivers, however, provide good fishing for channel catfish and carp. Flooding, drainage, and land use limit fish production in the streams. The future of existing stream habitat depends on a minimum flow of water and sound watershed management to control or reduce flooding. Some farm ponds stocked with bass, bluegill, and catfish provide both food and recreation.

The Wesco Girl Scout Camp near Nelson provides group camping facilities. Some areas offer potential for private camping around both natural and artificial lakes as well as along the Republican and Little Blue Rivers.

Technical assistance in planning wildlife developments and determining suitable species of vegetation can be obtained at the local office of the Soil Conservation Service in Nelson. Additional information and assistance can be obtained from Nebraska Game and Parks Commission, the Fish and Wildlife Service, and the Federal Extension Service. The Soil Conservation Service also provides technical assistance in the planning and application of management for outdoor recreation facilities.

Engineering [5]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small building, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5, 6, and 7, which show, respectively, results of engineering laboratory tests on soil samples, estimates of soil properties significant in engineering, and interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 5, 6, and 7, and it also can be used to make other useful maps.

This information, however, is not intended for use in design and does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some terms used in this soil survey have special meanings in soil science that may not be familiar to engineers. The Glossary defines many of these terms.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system *(2)* used by the SCS engineers, Department of Defense, and others, and the AASHTO system *(1)* adopted by the American Association of State Highway and Transportation Officials.

The Unified system is used to classify soils according to engineering uses for building material or for the support of structures other than highways. Soils are classified according to particle-size distribution, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes. There are eight classes of coarse-grained soils that are subdivided on the basis of gravel and sand content. These are identified as GW, GP, GM, GC, SW, SP, SM, and SC. Six classes of fine-grained soils are subdivided on the basis of the plasticity index. Nonplastic classes are ML, MH, OL, and OH; plastic classes are CL and CH. There is one class of highly organic soils, Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example CL–ML.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is classified in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils, which have high bearing strength and are the best soils for subgrade, or foundation. At the other extreme, in group A–7, are clay soils, which have

[5] JOHN E. OVERING, area engineer, Soil Conservation Service, helped prepare this section.

TABLE 5.—*Engineering*

[Tests performed by the Nebraska Department of Roads in accordance with standard

Soil name and location	Parent material	Report number S71–	Depth	Specific gravity [1]
			Inches	
Crete silt loam: 1,056 feet north and 100 feet east of the southwest corner of sec. 13, T. 14 N., R. 5 W. (Modal profile).	Peoria loess	1311 1312 1313	5–11 14–26 40–52	2.60 2.68 2.69
Geary silt loam: 790 feet south and 50 feet east of the northwest corner of sec. 3, T. 2 N., R. 5 W. (Modal profile).	Loveland formation (loess)	1320 1321 1322	0–10 15–29 42–62	2.63 2.69 2.69
Hastings silt loam: 1,056 feet west and 150 feet north of the southeast corner of sec. 22, T. 2 N., R. 6 W. (Modal profile).	Peoria loess	1317 1318 1319	0–10 13–25 42–62	2.62 2.68 2.69
Holder silt loam: 300 feet east and 150 feet north of the southwest corner of the SE¼ sec. 33, T. 1 N., R. 8 W. (Modal profile).	Peoria loess	1323 1324 1325	0–10 13–25 39–62	2.60 2.68 2.67
Hord silt loam: 790 feet north and 100 feet east of southwest corner of sec. 28, T. 1 N., R. 6 W. (Modal profile).	Silty alluvium	1314 1315	6–14 20–38	2.63 2.67

[1] Specific gravity based on standard procedure, AASHTO Designation T 100–70.

[2] Mechanical analyses according to the American Association of State Highway and Transportation Officials Designation T88 47 (*1*). Results by this procedure frequently may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine

low strength when wet and are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 5; the estimated classification, without group index numbers, is given in table 6 for all soils mapped in the survey area.

Engineering test data

Table 5 contains engineering test data for some of the major soil series in Nuckolls County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The mechanical analyses were made by combined sieve and hydrometer methods.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as is explained for table 6.

Specific gravity is the ratio of the unit weight of the soil solids to the unit weight of water. It is a measure of, and a means of expressing, the heaviness of soil. The specific gravity of the solid particles of a soil, exclusive of the void spaces, is also called the "true" or "real" specific gravity. This property has an important influence on the density of the soil.

Estimated soil properties

Several estimated soil properties significant in engineering are given in table 6. These estimates are made by layers of representative soil profiles having significantly different soil properties. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 6.

Depth to bedrock is the distance from the surface of the soil to a rock layer within the depth of observation.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches into the soil in most years.

Soil texture is described in table 6 in the standard terms used by the Department of Agriculture. These terms are based on the percentages of sand, silt, and

test data

procedures of the American Association of State Highway and Transportation Officials (AASHTO)]

Mechanical analysis [2]							Liquid limit	Plasticity index	Classification	
Percentage passing sieve			Percentage smaller than—						AASHTO [3]	Unified [4]
No. 40 (0.42 mm)	No. 60 (0.25 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm				
							Percent			
--	100	99	94	53	33	27	43	20	A-7-6(13)	CL
--	100	99	97	68	46	42	55	33	A-7-6(20)	CH
100	99	99	97	58	35	26	46	24	A-7-6(15)	CL
--	100	95	88	44	27	24	44	20	A-7-6(13)	CL
--	100	96	82	51	32	30	44	23	A-7-6(14)	CL
100	99	96	86	50	35	32	47	28	A-7-6(17)	CL
--	100	99	93	51	35	30	48	23	A-7-6(15)	CL
--	--	100	96	69	48	42	59	34	A-7-6(21)	CH
--	100	99	95	54	32	23	45	23	A-7-6(14)	CL
--	100	99	93	47	26	21	41	16	A-7-6(11)	CL
--	--	100	92	59	40	34	56	33	A-7-6(20)	CH
--	100	99	92	52	28	23	37	15	A-6(10)	CL
100	99	96	90	37	20	16	31	8	A-4(8)	ML
100	99	98	96	52	29	26	43	22	A-7-6(13)	CL

material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soil.

[3] Based on AASHTO Designation M 145-49 (*1*).

[4] Based on ASTM Standard Designation 2487-69 (*2*).

clay in the less than 2 millimeter fraction of the soil. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Liquid limit and plasticity index are water contents obtained by specified operations. As the water content of a dry clayey soil from which the particles coarser than 0.42 millimeter have been removed is increased, the material changes from semisolid to plastic. If the moisture content is further increased, the material changes from plastic to liquid. The plastic limit is the moisture content at which the soil material changes from semisolid to a plastic; and the liquid limit, from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of water content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 6, but in table 5 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability, as used in table 6, is the estimated rate at which saturated soil transmits water in a vertical direction under a unit head of pressure. It is estimated on basis of those soil characteristics observed in the field, particularly structure, porosity, and texture. Lateral seepage or such transient soil features as plowpans and surface crusts are not considered.

Available water capacity is the estimated capacity of soils to hold water for use by most plants. It is the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most plants.

Reaction refers to the acidity or alkalinity of a soil, expressed in pH values for a stated soil-solution mixture. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential refers to the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks when dry and swells when wet. The extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils may damage building foundations, roads, and other structures. Soils having a *high* shrink-swell potential are the most hazardous. Shrink-swell is not indicated for organic soils or certain soils that

TABLE 6.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear in the first column of this

Soil series and map symbols	Depth to— Bedrock	Depth to— Seasonal high water table	Depth from surface	USDA texture
	Ft	*Ft*	*In*	
Butler: Bu	>10	>10	0–12	Silt loam
			12–32	Silty clay
			32–43	Silty clay loam
			43–60	Silt loam
Cass: Ca	>5	5–7	0–11	Loam
			11–30	Fine sandy loam
			30–38	Loamy very fine sand
			38–48	Loam
			48–60	Loamy coarse sand
Cozad: Co	>5	5–8	0–10	Silt loam
			10–60	Silt loam
Crete: Cr	>10	>10	0–14	Silt loam and silty clay loam
			14–32	Silty clay
			32–40	Silty clay loam
			40–60	Silt loam
Fillmore: Fm, Fo	>10	>10	0–11	Silt loam
			11–31	Silty clay
			31–47	Silty clay loam
			47–60	Silt loam
*Geary:				
GaC, GaD, GgC	>5	>10	0–10	Silt loam
For Jansen part of GgC, see Jansen soil.			10–38	Silty clay loam
			38–60	Heavy silt loam
GeC2, GeD2, GfF, GfF3, GhD2, GhF	>5	>10	0–22	Silty clay loam
For Jansen part of GhD2 and GhF, see Jansen series.			22–60	Heavy silt loam
Gibbon: Gn	>5	2–4	0–30	Silt loam
			30–60	Very fine sandy loam
Hall: Ha, Hb	>10	>10 in unit Ha;	0–25	Silt loam
		5–8 in unit Hb.	25–45	Silty clay loam
			45–60	Silt loam
Hastings:				
Hc, HcB, HcC	>10	>10	0–11	Silt loam
			11–33	Silty clay loam
			33–60	Silt loam
HdC2	>10	>10	0–20	Silty clay loam
			20–60	Silt loam
Hobbs:				
HeB	>5	5–15		
Most properties are too variable to be rated. Onsite determinations necessary.				
Hf	>5	5–7	0–34	Silt loam
			34–60	Silt loam
Holder:				
HgB, HgC, HgD	>10	>10	0–13	Silt loam
			13–25	Light silty clay loam
			25–60	Silt loam
HhC2, HhD2	>10	>10	0–17	Silty clay loam
			17–60	Silt loam

See footnote at end of table.

significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for table. Symbol > means more than; symbol < means less than]

Classification		Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHTO	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
						Pct		*In/hr*	*In/in of soil*	*pH*	
ML, CL	A–6 or A–4			100	95–100	25–40	5–15	0.6–2.0	0.22–0.24	6.1–6.5	Moderate.
CH	A–7			100	98–100	51–65	30–40	0.06–0.2	0.11–0.13	6.6–7.8	High.
CL	A–7 or A–6			95–100	95–100	35–50	15–30	0.2–0.6	0.18–0.20	7.9–8.4	High.
CL	A–6			95–100	95–100	30–40	15–20	0.6–2.0	0.20–0.22	7.9–8.4	Moderate.
CL or CL–ML	A–4 or A–6	95–100	95–100	85–95	65–75	25–35	5–15	0.6–2.0	0.20–0.22	5.6–6.0	Low.
SM	A–4 or A–2	100	95–100	90–95	20–50		[1] NP	2.0–6.0	0.15–0.17	6.1–6.5	Low.
SM	A–2	100	95–100	65–90	15–35		NP	2.0–6.0	0.13–0.15	6.1–6.5	Low.
CL or CL–ML	A–4 or A–6	100	95–100	85–95	60–75	25–35	5–15	0.6–2.0	0.17–0.19	6.6–7.3	Low.
SM	A–2	100	95–100	55–75	15–30		NP	6.0–20.0	0.08–0.10	6.6–7.3	Low.
CL or CL–ML	A–4, A–6		100	95–100	90–100	25–35	5–15	0.6–2.0	0.22–0.24	6.6–7.3	Low.
ML, CL, CL–ML	A–4, A–6		100	95–100	90–100	20–35	4–12	0.6–2.0	0.20–0.22	7.4–8.4	Low.
CL	A–6 or A–7		100	95–100	90–100	30–45	12–20	0.2–2.0	0.21–0.24	6.1–6.5	Moderate to high.
CH	A–7		100	95–100	95–100	51–65	30–40	0.06–0.2	0.11–0.13	6.6–7.3	High.
CL	A–7 or A–6		100	95–100	95–100	35–50	20–25	0.02–0.6	0.18–0.20	7.4–7.8	Moderate.
CL	A–4 or A–6		100	95–100	95–100	30–40	8–20	0.6–2.0	0.20–0.22	7.4–7.8	Moderate.
ML or CL	A–4 or A–6			100	95–100	25–40	2–15	0.6–2.0	0.22–0.24	6.1–6.5	Low.
CH	A–7			100	95–100	51–70	30–45	<0.06	0.11–0.13	6.6–7.8	High.
CL	A–7 or A–6		100	95–100	95–100	35–50	20–30	0.2–0.6	0.18–0.20	7.9–8.4	Moderate to high.
CL	A–4 or A–6		100	95–100	95–100	25–40	8–20	0.6–2.0	0.20–0.22	7.9–8.4	Moderate.
CL	A–6, A–7	100	95–100	95–100	90–100	35–50	15–25	0.6–2.0	0.22–0.24	6.1–6.5	Moderate.
CL	A–7 or A–6	100	95–100	95–100	85–100	40–50	20–30	0.2–0.6	0.18–0.20	6.6–7.3	Moderate.
CL	A–6, A–7		100	95–100	90–100	35–50	15–30	0.6–2.0	0.20–0.22	6.6–7.3	Moderate.
CL	A–7 or A–6	100	95–100	95–100	85–100	40–50	20–30	0.2–0.6	0.21–0.23	6.1–7.3	Moderate.
CL	A–6, A–7		100	95–100	90–100	40–50	15–30	0.6–2.0	0.20–0.22	6.6–7.3	Moderate.
CL or ML	A–6 or A–4	100	98–100	95–100	90–100	30–40	5–20	0.6–2.0	0.22–0.24	6.6–9.0	Moderate.
ML, CL	A–4	100	95–100	85–95	51–65	0–25	2–10	0.6–2.0	0.17–0.19	8.5–9.0	Low.
ML or CL	A–4 or A–6		100	95–100	95–100	30–40	5–15	0.6–2.0	0.22–0.24	6.1–6.5	Low to moderate.
CL	A–7 or A–6		100	95–100	95–100	40–50	20–30	0.2–0.6	0.18–0.20	6.6–7.3	Moderate.
CL or CL–ML	A–6		100	95–100	90–100	25–40	11–20	0.6–2.0	0.20–0.22	6.6–7.8	Moderate.
CL	A–6, A–7		100	95–100	95–100	35–50	11–25	0.6–2.0	0.22–0.24	6.1–6.5	Moderate.
CH or CL	A–7		100	95–100	98–100	45–65	25–40	0.2–0.6	0.18–0.20	6.1–7.8	High.
CL	A–6, A–7	100	95–100	95–100	95–100	35–50	11–25	0.6–2.0	0.20–0.22	7.4–7.8	Moderate.
CH or CL	A–7		100	95–100	95–100	45–65	25–40	0.2–0.6	0.18–0.20	6.1–7.3	High.
ML or CL	A–6, A–7	100	95–100	95–100	95–100	35–50	11–25	0.6–2.0	0.20–0.22	7.4–7.8	Moderate.
CL or ML	A–6, A–4		100	95–100	95–100	32–40	8–15	0.6–2.0	0.20–0.24	6.6–7.3	Moderate.
ML or CL	A–4 or A–6		100	95–100	90–100	35–40	6–15	0.6–2.0	0.20–0.22	6.6–7.3	Moderate.
CL	A–6, A–7		100	95–100	95–100	35–45	11–20	0.6–2.0	0.22–0.24	6.1–6.5	Moderate.
CL, CH	A–7 or A–6			100	98–100	35–60	25–40	0.6–2.0	0.18–0.20	6.6–7.3	Moderate.
CL or ML	A–4 or A–6	100	98–100	95–100	90–100	30–40	8–20	0.6–2.0	0.20–0.22	6.6–7.8	Moderate.
CL or CH	A–7 or A–6			100	98–100	35–60	25–40	0.6–2.0	0.18–0.20	6.1–7.3	High.
CL	A–6, A–7	100	98–100	95–100	90–100	30–45	11–20	0.6–2.0	0.20–0.22	6.6–7.8	Moderate.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to— Bedrock	Depth to— Seasonal high water table	Depth from surface	USDA texture
	Ft	*Ft*	*In*	
Hord: Hr, HrB, HrC	>10	10	0–14 14–60	Silt loam Silt loam
Inavale:				
Ig	>5	>6	0–7 7–60	Loamy fine sand Loamy sand
In	>5	5–7	0–7 7–60	Fine sandy loam Loamy sand
Jansen Mapped only with Geary soils.	>5	>10	0–13 13–24 24–60	Silt loam Clay loam Sand and gravel
Kipson: KsF	1–2	>10	0–18 18–36	Silt loam Silty shale.
Marsh: Ma Most properties are too variable to be rated. Onsite determinations necessary.	>10	Slightly above surface to depth of 1 foot.		
McCook:				
Mb	>5	4–6	0–13 13–60	Fine sandy loam Very fine sandy loam
Mc	>5	4–6	0–13 13–60	Silt loam Very fine sandy loam
Meadin: MdF	>5	>10	0–9 9–15 15–60	Loam Gravelly sandy loam Sand and gravel
Munjor: Mu	>5	>6	0–15 15–24 24–34 34–60	Loam and very fine sandy loam Sandy loam Loamy fine sand Very fine sandy loam
Saline-alkali land: Sa Most properties too variable to be rated. Onsite determinations necessary.	>5	0–3		
Sandy alluvial land: Sb Most properties are too variable to be rated. Onsite determinations necessary.	>5	0–2		
Scott: Sc	>10	>10	0–8 8–39 39–52 52–60	Silt loam Silty clay Silty clay loam Silt loam
Uly: UyF, UyF2	>10	>10	0–9 9–24 24–60	Silt loam Silt loam Silt loam
Wann:				
Wb	>5	2–5	0–11 11–38 38–60	Fine sandy loam Loamy very fine sand Loamy fine sand
Wm	>5	2–5	0–11 11–16 16–38 38–60	Loam Very fine sandy loam Loamy very fine sand Loamy fine sand

[1] NP means nonplastic.

significant in engineering—Continued

Classification		Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHTO	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
						Pct		*In/hr*	*In/in of soil*	*pH*	
ML or CL	A–4 or A–6	100	98–100	95–100	90–100	25–40	5–15	0.6–2.0	0.22–0.24	6.1–6.6	Moderate.
CL	A–6, A–7	100	98–100	95–100	90–100	35–50	15–30	0.6–2.0	0.20–0.22	6.6–7.8	Moderate.
SM	A–2	100	95–100	85–95	15–30	-------	NP	6.0–20.0	0.10–0.12	7.4–7.8	Low.
SM	A–2	100	90–100	65–75	15–25	-------	NP	6.0–20.0	0.08–0.11	7.4–7.8	Low.
SM	A–4, A–2	100	95–100	70–85	30–50	-------	NP	2.0–6.0	0.13–0.15	7.4–7.8	Low.
SM	A–2	100	90–100	65–75	15–25	-------	NP	6.0–20.0	0.08–0.11	7.4–7.8	Low.
ML or CL	A–4 or A–6	100	95–100	90–100	80–95	25–35	5–15	0.6–2.0	0.22–0.24	5.6–6.5	Moderate.
CL	A–6, A–7	95–100	90–100	80–95	70–80	40–45	15–25	0.6–2.0	0.15–0.19	6.1–6.5	Moderate.
SW or SW–SM	A–3	85–100	85–90	35–60	3–11	-------	NP	>20.0	0.02–0.04	6.1–6.5	Low.
CL–ML or CL	A–6 or A–4	100	70–95	65–90	60–95	25–40	5–20	0.6–2.0	0.22–0.24	7.4–8.4	Moderate.
SM or ML	A–4	-------	100	70–85	36–55	-------	NP	2.0–6.0	0.16–0.18	7.9–8.4	Low.
ML or SM	A–4	-------	100	95–100	45–75	0–20	2–7	0.6–2.0	0.17–0.19	7.9–8.4	Low.
CL or CL–ML	A–4	-------	100	95–100	65–95	25–35	5–10	0.6–2.0	0.20–0.22	7.9–8.4	Low.
ML	A–4	-------	100	95–100	55–75	0–20	2–7	0.6–2.0	0.17–0.19	7.9–8.4	Low.
CL or ML	A–4	100	90–100	60–95	55–70	20–35	2–10	0.6–2.0	0.22–0.24	6.1–6.5	Low.
SM, SP–SM	A–2	50–90	35–87	21–60	10–35	-------	NP	2.0–6.0	0.12–0.14	6.1–6.5	Low.
SP, SP–SM	A–1, A–3	90–100	75–90	30–70	2–12	-------	NP	>20.0	0.02–0.04	6.1–6.5	Low.
ML, CL, SC or SM	A–4	-------	100	85–95	40–70	20–30	3–10	0.6–2.0	0.22–0.24	7.4–8.4	Low.
SM, SC, ML, CL	A–4	95–100	95–100	65–85	35–65	10–25	3–10	2.0–6.0	0.12–0.14	7.9–8.4	Low.
SM	A–2	98–100	95–100	60–80	5–30	-------	NP	6.0–20.0	0.09–0.11	7.4–7.9	Low.
ML, CL–ML, SM or SM–SC	A–4	-------	100	90–95	45–70	0–25	3–7	0.6–2.0	0.17–0.19	8.5–9.0	Low.
ML	A–4 or A–6	-------	-------	100	95–100	25–35	2–10	0.6–2.0	0.22–0.24	6.1–6.5	Moderate.
CH	A–7	-------	-------	100	98–100	51–70	30–45	<0.06	0.11–0.14	6.6–7.3	High.
CL or CH	A–7	-------	-------	100	95–100	45–55	25–40	0.2–0.6	0.18–0.20	6.6–7.3	High.
CL	A–4, A–6	-------	100	100	95–100	30–40	8–15	0.6–2.0	0.20–0.22	7.4–7.8	Moderate.
ML or CL	A–4 or A–6	-------	-------	100	95–100	25–35	5–15	0.6–2.0	0.22–0.24	6.1–6.5	Moderate.
CL or ML	A–4 or A–6	-------	100	100	98–100	30–40	10–20	0.6–2.0	0.20–0.22	6.1–7.3	Moderate.
ML or CL	A–4 or A–6	-------	100	100	95–100	25–35	5–20	0.6–2.0	0.20–0.22	7.4–7.8	Low.
SM or SM–SC	A–2, A–4	100	95–100	70–85	30–45	0–20	0–5	2.0–6.0	0.16–0.18	7.4–8.4	Low.
SM or ML	A–2 or A–4	100	95–100	90–95	30–55	-------	NP	2.0–6.0	0.13–0.15	8.5–9.0	Low.
SM	A–2	100	90–100	50–75	10–30	-------	NP	6.0–20.0	0.08–0.10	8.5–9.0	Low.
CL or CL–ML	A–4	-------	100	85–95	55–75	25–30	5–10	0.6–2.0	0.20–0.22	7.4–8.4	Low.
ML or CL–ML	A–4	-------	100	90–95	51–65	20–34	3–7	0.6–2.0	0.17–0.19	8.5–9.0	Low.
SM or ML	A–2 or A–4	100	95–100	90–95	30–55	-------	NP	2.0–6.0	0.13–0.15	8.5–9.0	Low.
SM	A–2	100	90–100	50–75	10–30	-------	NP	6.0–20.0	0.08–0.10	8.5–9.0	Low.

TABLE 7.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that appear in the first column of this

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	Local roads and streets
Butler: Bu	Severe: slow permeability; occasional flooding of short duration.	Severe: may require protection because of occasional flooding.	Severe: subsoil is difficult to work; occasional flooding.	Severe: high shrink-swell potential; occasional flooding; susceptible to frost action.	Trench: severe; clayey subsoil. Area: moderate; occasional flooding; surface layer is poor cover material, too clayey.	Severe: high shrink-swell potential; occasional flooding; subject to frost action.
Cass: Ca	Severe: occasional flooding.[2]	Severe: moderately rapid permeability; occasional flooding.	Severe: poor sidewall stability; flooding.	Severe: occasional flooding.	Trench and area: severe; occasional flooding; moderately rapid permeability; good cover soil.[2]	Moderate: occasional flooding.
Cozad: Co	Moderate: seasonal high water table at a depth of 5 to 8 feet.	Moderate: moderate permeability.	Slight	Moderate: moderate shrink-swell potential.	Trench and area: slight; good cover material.	Moderate: susceptible to frost action; low strength.
Crete: Cr	Severe: slow permeability to a depth of 3.5 feet; moderate permeability below 3.5 feet.	Slight: moderate permeability below a depth of 3.5 feet.	Severe: clayey subsoil.	Severe: high shrink-swell potential in subsoil.	Trench: severe; high clay content in subsoil. Area: moderate wetness; poor cover material, too clayey.	Severe: high shrink-swell potential.
Fillmore: Fm	Severe: occasional flooding; very slow permeability.	Severe: occasional flooding.	Severe: occasional flooding; subsoil is difficult to work.	Severe: occasional flooding; high shrink-swell potential.	Trench and area: severe; occasional flooding; poor cover material, too clayey.	Severe: occasional flooding; high shrink-swell potential.
Fo	Severe: very slow permeability.	Slight	Severe: silty clay subsoil is difficult to work.	Severe: high shrink-swell potential.	Trench and area: severe; high clay content in subsoil; poor cover material, too clayey.	Severe: high shrink-swell potential.

See footnotes at end of table.

engineering properties

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions table. Some terms in this table are explained in the Glossary]

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Poor: high shrink-swell potential.	Unsuited	Fair: thin layer.	Low seepage; good storage potential; can be used for dugouts.	High shrink-swell potential; fair to poor compaction; poor workability; low permeability of compacted soil.	Slow internal drainage; slow surface drainage; susceptible to ponding.	High available water capacity; slow intake rate; susceptible to ponding.	([1]).
Good	Fair: gradation limited to finer sizes.	Good in upper part of profile.	High seepage; moderately rapid permeability; nearly level; reduced storage potential.	Fair to good compaction; medium to high seepage rate.	Moderately rapid permeability; susceptible to rare flooding.	Moderate available water capacity; moderately high intake rate.	([1]).
Fair: susceptible to frost action; low shrink-swell potential.	Unsuited	Good	Low seepage; moderate permeability; nearly level; reduced storage potential.	Medium susceptibility to piping; low permeability of compacted soil; fair to poor compaction.	Well drained; slow runoff.	High available water capacity; moderate irtake rate; easy to work.	([1]).
Poor: high shrink-swell potential.	Unsuited	Fair: thin layer.	Low seepage; nearly level; reduced storage potential.	High compressibility; high shrink-swell potential; low permeability of compacted soil.	Slow permeability; slow surface drainage.	High available water capacity; slow permeability; low intake rate.	([1]).
Poor: high shrink-swell potential; susceptible to frost action and flooding.	Unsuited	Fair: thin layer.	Low seepage; very slow permeability.	High shrink-swell potential; cracks when dry; erodible slopes; high compressibility; low permeability of compacted soil.	Subject to ponding, slow internal drainage; outlets not readily available.	Low intake rate; poor surface drainage; high available water capacity; occasional flooding.	([1]).
Poor: high shrink-swell potential; susceptible to frost action.	Unsuited	Good	Low seepage; very slow permeability.	Fair to good compactibility; cracks when dry; erodible slope.	Slow internal drainage; slow runoff.	Low intake rate; high available water capacity.	([1]).

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	Local roads and streets
*Geary:						
GaC, GeC2, GgC. For Jansen part of GgC, see Jansen soil.	Moderate: moderately slow permeability.	Moderate: slopes are less than 7 percent.	Slight.	Moderate: moderate shrink-swell potential.	Trench: moderate; too clayey. Area: slight; fair cover material.	Moderate: moderate shrink-swell potential; low strength.
GaD, GeD2, GhD2. For Jansen part of GhD2, see Jansen soil.	Moderate: moderately slow permeability.	Severe: slopes generally more than 7 percent.	Moderate: slopes more than 6 percent.	Moderate: slope; moderate shrink-swell potential.	Trench: moderate; too clayey; fair cover material, too clayey; slope.	Moderate: moderate shrink-swell potential; slope.
GfF, GfF3, GhF. For Jansen part of GhF, see Jansen soil.	Moderate where slopes are less than 15 percent. Severe where slopes are more than 15 percent; moderately slow permeability.	Severe: slopes generally more than 7 percent.	Moderate where slopes are less than 15 percent. Severe where slopes are more than 15 percent.	Moderate where slopes are more than 15 percent. Severe where slopes are less than 15 percent.	Trench: moderate where slopes are less than 15 percent; severe where slopes are more than 15 percent. Area: moderate where slopes are less than 15 percent; severe where slopes are more than 15 percent. Fair cover material; slopes less than 15 percent; severe cover material; slopes more than 15 percent.	Moderate where slopes are less than 15 percent. Severe where slopes are more than 15 percent; moderate shrink-swell potential.
Gibbon: Gn.	Severe: seasonal high water table at a depth of 2 to 4 feet.	Severe: seasonal high water table at a depth of 2 to 4 feet.	Severe: seasonal high water table at a depth of 2 to 4 feet.	Severe: seasonal high water table at a depth of 2 to 4 feet.	Trench and area: severe: seasonal high water table at a depth of 2 to 4 feet; good cover material.	Severe: seasonal high water table at a depth of 2 to 4 feet; subject to frost action.
Hall: Ha, Hb.	Moderate: moderately slow permeability; seasonal high water table at a depth of 5 to 8 feet in unit Hb.	Slight.	Slight.	Moderate: moderate shrink-swell potential.	Trench and area: slight; good cover material.	Moderate: moderate shrink-swell potential; subject to frost action.

See footnotes at end of table.

engineering properties—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Fair: moderate shrink-swell potential.	Unsuited	Fair: thin layer.	Low seepage; good storage potential; moderately slow permeability.	Moderate shrink-swell potential; fair to good compaction; low permeability of compacted soils.	Well drained; medium runoff.	High available water capacity; erodible.	Erodible slope.
Fair: moderate shrink-swell potential.	Unsuited	Fair: slope; thin layer.	Low seepage; good storage potential; moderately slow permeability.	Erodible slope; fair to good compaction characteristics; low permeability of compacted soil.	Well drained; medium to rapid runoff.	High available water capacity; erodible slope.	Erodible slope.
Poor: slope; moderate shrink-swell potential.	Unsuited	Poor: slope	Low seepage; moderately slow permeability.	Fair to good compaction characteristics; low permeability of compacted soil.	Well drained; rapid runoff.	(1)	(1).
Poor: water table at a depth of 2 to 4 feet; subject to frost action.	Unsuited	Good	High seepage potential below a depth of 3 feet; moderately high water table; nearly level topography.	Susceptible to piping hazard; fair compactibility; medium to low permeability of compacted soil.	Moderately high water table; adequate outlets may be difficult to obtain; nearly level.	Moderately high water table; high available water capacity; moderate permeability.	(1).
Fair: moderate shrink-swell potential; high compressibility.	Unsuited	Good	Low storage potential because of nearly level slopes; moderately slow permeability.	Fair to good compaction; medium susceptibility to piping; erodible slopes.	Well drained; moderately slow permeability.	High available water capacity; moderate intake rate.	(1).

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	Local roads and streets
Hastings:						
Hc, HcB	Moderate: moderately slow permeability.	Slight where slopes are less than 2 percent. Moderate where slopes are more than 2 percent.	Slight	Severe: high shrink-swell potential; subject to frost action.	Trench: moderate; too clayey. Area: slight; good cover material in upper 1 foot depth; fair in subsoil.	Severe: high shrink-swell potential; subject to frost action.
HcC, HdC2	Moderate: moderately slow permeability.	Moderate: slopes more than 2 percent.	Slight	Severe: high shrink-swell potential; subject to frost action.	Trench: moderate; too clayey. Area: slight; good or fair cover material.	Severe: high shrink-swell potential; subject to frost action.
Hobbs:						
HeB	Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.	Trench and area: severe; frequent flooding; good cover material.	Severe: frequent flooding.
Hf	Severe: occasionally flooded.	Severe: occasionally flooded.	Severe: occasionally flooded.	Severe: occasionally flooded.	Trench and area: severe; occasionally flooded; good cover material.	Severe: occasionally flooded.
Holder:						
HgB	Moderate: moderate permeability.	Slight where slopes are less than 2 percent. Moderate where slopes are more than 2 percent.	Slight	Moderate: moderate shrink-swell potential.	Trench and area: slight; good cover material.	Moderate: moderate shrink-swell potential; subject to frost action.
HgC, HhC2	Moderate: moderate permeability.	Moderate: slope.	Slight	Moderate: moderate shrink-swell potential.	Trench and area: slight; good cover material.	Moderate: moderate shrink-swell potential; subject to frost action.
HgD, HhD2	Moderate: moderate permeability; slope.	Severe: slope	Slight for slopes less than 8 percent; moderate for slopes more than 8 percent.	Moderate: slope; moderate shrink-swell potential.	Trench: slight. Area: moderate slope; fair cover material, slope.	Moderate: moderate shrink-swell potential; slope.

See footnotes at end of table.

engineering properties—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Poor: high shrink-swell potential.	Unsuited	Fair: too clayey.	Low seepage if soil is compacted; moderately slow permeability.	Good to fair stability; low permeability of compacted soil; fair to good compaction.	Well drained; moderately slow permeability.	High available water capacity; moderately slow permeability; moderately slow intake rate.	Erodible slope.
Poor: high shrink-swell potential.	Unsuited	Fair: too clayey.	Low seepage, good storage potential; moderately slow permeability.	Good to fair stability; low permeability of compacted soil.	Well drained; moderately slow permeability; gently sloping.	High available water capacity; moderately slow permeability; moderately low intake rate.	([1]).
Fair: subject to frost action; frequently flooded.	Unsuited	Fair: frequently flooded; texture of material is good.	Low seepage; frequently flooded.	Susceptibility to piping; medium to low permeability of compacted soil; fair to poor compaction.	Frequently flooded; moderate permeability.	Frequently flooded.[1]	([1]).
Fair with compaction control.	Unsuited	Good	Moderate seepage potential; moderate permeability.	Susceptible to piping; subject to frost action; medium compressibility.	Subject to overflow; fair to good internal drainage; moderate permeability.	High available water capacity; occasionally flooded; moderate permeability.	([1]).
Fair: moderate shrink-swell potential; good compaction characteristics.	Unsuited	Good	Low seepage; moderate permeability.	Fair to good compaction characteristics; low permeability for compacted soil.	Well drained; runoff slow; moderate permeability.	High available water capacity; moderate intake rate; easily worked.	Erodible slope; easily worked.
Fair: moderate shrink-swell potential; good compaction characteristics.	Unsuited	Good	Low seepage; good storage potential; moderate permeability.	Fair to good compaction characteristics; low permeability for compacted soil.	Well drained; gently sloping; runoff medium; moderate permeability.	High available water capacity; moderate intake rate; easily worked; erodible slope.	Erodible slope; easily worked.
Fair: moderate shrink-swell potential; good compaction characteristics.	Unsuited	Fair: slope	Low seepage; good storage potential; moderate permeability.	Fair to good compaction characteristics; low permeability for compacted soil.	Well drained; strongly sloping; runoff rapid; moderate permeability.	High available water capacity; erodible slope; moderate intake rate; easily worked.	Erodible slope.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	Local roads and streets
Hord: Hr, HrB, HrC	Slight	Moderate: moderate permeability.	Slight	Slight	Trench and area: slight; good cover material.	Moderate: low strength.
Inavale: Ig, In	Moderate: subject to rare flooding; seasonal high water table at a depth of 5 to 7 feet.[2]	Severe: rapid permeability; subject to flooding.	Severe: subject to flooding; poor sidewall stability.	Severe: subject to flooding; basement excavations subject to caving.	Trench and area: severe; rapid permeability; subject to flooding. Poor cover material; too sandy.[2]	Moderate: low shrink-swell potential; subject to frost action.
Jansen. Mapped only with Geary soils.	Moderate: moderate permeability in subsoil; very rapid permeability below a depth of about 3 feet; severe for slopes more than 15 percent.[2]	Severe: moderate permeability in subsoil; very rapid permeability below a depth of about 3 feet; severe for slopes more than 7 percent.	Severe: poor sidewall stability below a depth of 3 feet; severe for slopes more than 15 percent.	Slight where slopes are less than 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent; poor sidewall stability in excavations for basements.	Trench and area: severe; very rapid permeability below a depth of about 3 feet; poor cover material; area reclaim.[2]	Severe: subject to frost action; some slopes more than 15 percent.
Kipson: KsF	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.	Moderate: rippable bedrock at a depth of 10 to 20 inches.	Moderate: rippable bedrock at a depth of 10 to 20 inches.	Trench: severe; bedrock at a depth of 10 to 20 inches. Area: less than 8 percent slopes. Slight where slopes are 8 to 15 percent. Moderate where slopes are more than 15 percent. Severe: poor for cover soil.	Moderate: rippable bedrock at a depth of 10 to 20 inches.
Marsh: Ma	Severe: frequent flooding or very high water table.	Severe: frequent flooding or very high water table.	Severe: frequent flooding or very high water table.	Severe: frequent flooding or very high water table.	Trench and area: severe; frequent flooding or very high water table.	Severe: frequent flooding or very high water table.
McCook: Mb, Mc	Moderate: seasonal high water table at a depth of 4 to 6 feet; rare flooding.	Severe: seasonal high water table at a depth of 4 to 6 feet; rare flooding.	Moderate: rare flooding; seasonal high water table at a depth of 4 to 6 feet.	Severe: rare flooding.	Trench and area: moderate; rare flooding; good cover material.	Moderate: rare flooding.

See footnotes at end of table.

engineering properties—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Fair: needs compaction control.	Unsuited	Good	Moderate seepage; easy workability.	High susceptibility to piping; fair compactibility; medium consolidation when wetted and loaded.	Well drained; slow runoff; moderate permeability.	High available water capacity; nearly level or very gently sloping.	(1).
Good	Fair: excess fines.	Fair for unit In; poor for unit Ig; thin layer.	High seepage, sandy substratum.	Susceptibility to piping; fair compactibility.	Somewhat excessively drained; rapid permeability.	Low available water capacity.	(1).
Fair above depth of 3 feet; moderate shrink-swell potential; good below 3 feet.	Good below a depth of 3 feet.	Fair: thickness may be lacking. Poor where slopes are more than 15 percent.	High seepage rate; very rapid permeability below a depth of 3 feet.	Susceptible to piping; very rapid permeability below a depth of 3 feet.	Well drained; medium to rapid runoff; very rapid permeability below a depth of 3 feet.	Sand and gravel below a depth of about 3 feet; moderate available water capacity; not suited on slopes above 11 percent.	Sand and gravel below a depth of about 3 feet; erodible; not suited on slopes above 11 percent.
Poor: shallow soil over bedrock.	Unsuited	Poor: shallow soil over bedrock.	High seepage rate; bedrock at a depth of 10 to 20 inches.	Erodible; poor stability; bedrock at a depth of 10 to 20 inches.	Somewhat excessively drained; bedrock at a depth of 10 to 20 inches; rapid runoff.	(1)	(1).
Poor: high water table or flooded.	Unsuited	Poor: high water table or flooded.	Low seepage; areas in uplands are flooded; low slopes.	Very wet because of high water table or flooding.	Slow internal drainage in upland areas; outlets may be difficult to locate; ponded.	(1)	(1).
Fair: low strength.	Unsuited	Good	Moderate seepage; water table at a depth of 4 to 6 feet.	Fair stability; good workability; low strength.	Water table at a depth of 4 to 6 feet.	High available water capacity; deep soil; nearly level.	(1).

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	Local roads and streets
Meadin: MdF	Moderate where slopes are less than 15 percent. Severe where slopes are more than 15 percent.[2]	Severe: very rapid permeability in sand and gravel.	Severe: sand and gravel give poor sidewall stability.	Severe: poor sidewall stability for basement excavations; good bearing value when confined; some slopes more than 15 percent.	Trench and area: severe; very rapid permeability in sand and gravel; poor cover material.[2]	Moderate where slopes are less than 15 percent. Severe where slopes are more than 15 percent.
Munjor: Mu	Severe: occasional flooding.[2]	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.	Trench and area: severe; occasional flooding; good cover material.	Moderate: occasional flooding.
Saline-alkali land: Sa	Severe: seasonal high water table at a depth of 0 to 2 feet.[2]	Severe: seasonal high water table at a depth of 0 to 2 feet.	Severe: seasonal high water table at a depth of 0 to 2 feet.	Severe: seasonal high water table at a depth of 0 to 2 feet.	Trench and area: severe; seasonal high water table at a depth of 0 to 2 feet; poor cover material.[2]	Severe: seasonal high water table at a depth of 0 to 2 feet.
Sandy alluvial land: Sb	Severe: frequent flooding.[2]	Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.	Trench and area: severe; frequent flooding; poor cover material.[2]	Severe: flooding.
Scott: Sc	Severe: frequent flooding; very slow permeability.	Severe: frequent flooding.	Severe: frequent flooding; difficult to work.	Severe: frequent flooding; high shrink-swell potential; subject to frost action.	Trench and area: severe; frequent flooding; poor workability; poor cover material.	Severe: frequent flooding; high shrink-swell potential; subject to frost action.
Uly: UyF, UyF2	Moderate where slopes are less than 15 percent. Severe where slopes are more than 15 percent.	Severe: slope	Moderate where slopes are less than 15 percent. Severe where slopes are more than 15 percent.	Moderate where slopes are less than 15 percent. Severe where slopes are more than 15 percent; low strength.	Trench: slight where slopes are less than 15 percent. Moderate where slopes are 15 to 25 percent. Severe where slopes are more than 25 percent.	Moderate where slopes are less than 15 percent. Severe where slopes are more than 15 percent; low strength.

See footnotes at end of table.

engineering properties—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Good	Good below a depth of 1 foot.	Poor: coarse textured.	High seepage; very rapid permeability in sand and gravel.[1]	Fair stability; pervious for clean sands.	Excessively drained; sand and gravel at a depth of 10 to 20 inches.	Shallow soil over sand and gravel; slopes too steep.[1]	([1]).
Fair: low strength.	Poor: check site for material below a depth of 4 feet.	Good	High seepage; dugouts may be possible; water table at a depth of 4 to 8 feet.	Good stability; medium to low permeability of compacted soil; fair compaction characteristics.	Water table at a depth of 4 to 8 feet; moderately rapid permeability.	Moderate available water capacity; moderately rapid permeability; subject to flooding.	([1]).
Poor: very poorly drained.	Not suited	Poor: high salinity and alkalinity.	Low seepage; water table at a depth of 0 to 2 feet.	Poor stability; water table at a depth of 0 to 2 feet.	Poor internal drainage; water table at a depth of 0 to 2 feet.	Water table at a depth of 0 to 2 feet; high salinity and alkalinity.[1]	([1]).
Good, but needs dewatering; poorly drained.	Fair: check site for gradation desired.	Poor: poorly drained; coarse texture.	High seepage; dugouts may be possible; water table at a depth of 0 to 2 feet.	Susceptible to piping; low compressibility; medium to high permeability of compacted soil.	Slow surface drainage; subject to flooding; rapid permeability.	Water table at a depth of 0 to 2 feet; frequently flooded.[1]	([1]).
Poor: high shrink-swell potential; subject to frost action.	Unsuited	Poor: frequent flooding; inadequate thickness of suitable material.	Low seepage, impervious; frequent flooding.	Impervious, poor stability; low permeability of compacted soil.	Very slow surface drainage; frequent flooding; slow internal drainage; adequate outlets may not be available.	High available water capacity; low intake rate; very slow permeability; difficult to work; outlets not readily available.	([1]).
Fair where slopes are less than 25 percent. Poor where slopes are more than 25 percent; low strength.	Unsuited	Fair where slopes are less than 15 percent. Poor where slopes are more than 15 percent.	Low seepage; moderately steep and steep slopes; moderate permeability.	Good stability; susceptibility to piping; medium to low permeability of compacted soil.	Well drained; rapid runoff.	([1])	([1]).

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	Local roads and streets
					Area: moderate where slopes are less than 15 percent. Severe where slopes are more than 15 percent; less than 15 percent, fair cover material; more than 15 percent, poor cover material.	
Wann: Wb, Wm	Severe: seasonal high water table at a depth of 2 to 5 feet.[2]	Severe: moderately rapid permeability; seasonal high water table at a depth of 2 to 5 feet; subject to rare flooding.	Severe: seasonal high water table at a depth of 2 to 5 feet; subject to caving.	Severe: seasonal high water table at a depth of 2 to 5 feet; subject to frost action; subject to rare flooding.	Trench and area: severe; moderately rapid permeability; good cover material.[2]	Severe: subject to frost action; subject to rare flooding.

[1] Because of soil characteristics, position, slope or topography, this practice is not suited or is not needed.
[2] Moderately rapid or rapid permeability may result in pollution of underground water supply.

shrink markedly on drying but do not swell quickly when rewetted.

Engineering interpretations

The estimated interpretations in table 7 are based on the engineering properties of soils shown in table 6, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Nuckolls County. In table 7, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions. For these particular uses, table 7 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are expressed as *slight, moderate,* and *severe. Slight* means that soil properties are generally favorable for the intended use, or in other words, limitations are minor and are easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* indicates soil properties so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required. For some uses, the rating of severe is divided to obtain ratings of severe and very severe.

Soil suitability is rated by the terms good, fair, and poor, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 7.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. It is assumed that the embankment is compacted to medium density and the pond is protected from flooding. Properties that affect the pond floor and the embankment are considered. Those that affect the pond floor are permeability, organic matter, and slope. If the floor needs to be leveled, depth to bedrock is important. The soil properties that affect

engineering properties—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Fair for compaction and workability; subject to frost action; water table at a depth of 2 to 5 feet.	Fair: check for gradation desired; sand may be below a depth of 5 feet.	Good	High seepage; water table at a depth of 2 to 5 feet.	High susceptibility to piping; fair compactibility; medium permeability of compacted soil.	Water table at a depth of 2 to 5 feet; moderately rapid permeability.	Moderate available water capacity; moderately high intake rate.	[1].

the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the content of stones, if any, that influences the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrop or big stones, and freedom from flooding or a high water table.

Dwellings, as rated in table 7, are no more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of solid waste, either in excavated trenches or on the surface of the soil. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 7 apply only to a depth of about 6 feet. Limitation ratings of *slight* or *moderate*, therefore, may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 or 15 feet, but regardless of that, every site should be investigated before it is selected.

Daily cover for sanitary landfill should be soil that is easy to excavate and spread over the compacted fill during both wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

In addition to these features, the soils selected for final cover of landfill should be suitable for growing plants. In comparison with other horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas, such as slope, erodibility, and potential for plant growth.

Local roads and streets, as rated in table 7, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load supporting capacity and stability of the subgrade, and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and the ease of excavating the material at borrow areas.

Sand is used in great quantities in many kinds of construction. The ratings in table 7 provide information about where to look for probable sources. A soil rated as a *good* or *fair* source of sand generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and they do not indicate quality of the deposit.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material, as in preparing a seedbed; the natural fertility of the material, or the response of plants when fertilizer is applied; and the absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability. Also considered in the ratings is damage that will result at the area from which topsoil is taken.

Pond reservoirs hold water behind a dam or embankment. Soils suitable as pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Stones and organic material in a soil are among the features that are unfavorable.

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in a fragipan or another layer that restricts movement of water; amount of water held available to plants; need for drainage, and depth to the water table or bedrock.[6]

Terraces and diversions are embankments or ridges constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Formation and Classification of Soils

This section tells how the factors of soil formation have affected the formation of soils in Nuckolls County. It also explains the system of soil classification currently used and classifies each soil series according to that system.

Factors of Soil Formation

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. It may be much or little, but some time is always required for differentiation of soil horizons. Generally, a long time is required for the formation of distinct horizons.

[6] Further information on soil use for irrigation is contained in "Irrigation Guide for Nebraska," Soil Conservation Service, 1971.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil formation are unknown.

Parent material

The soils of Nuckolls County formed in several kinds of parent material—loess, alluvium, water-deposited sand and gravel, and residuum weathered from chalky limestone.

Peoria Loess is the most extensive parent material in the county. This brownish to yellowish silt loam material ranges from a few feet to as much as 20 feet thick. Uly, Holder, Hastings, Crete, Butler, Fillmore, and Scott soils formed in Peoria Loess. They occupy upland areas throughout the county.

Alluvium consists of clay, silt, sand, or gravel that was washed from uplands and deposited on flood plains and stream terraces. This material is mixed in varying degrees and is commonly deposited in layers or lenses. Cass, Cozad, Gibbon, Hall, Hobbs, Hord, Inavale, McCook, Munjor and Wann soils formed in alluvium.

An older reddish to brownish material underlies the Peoria Loess. It is the Loveland Formation, commonly believed to be loess in origin. This reddish loess is exposed on the side slopes of many drainageways. It is older and more oxidized than Peoria Loess and contains slightly more sand. Loveland Loess is at the surface along the lower side slopes of drainageways throughout Nuckolls County and is in large areas along the deeply entrenched tributaries and drainageways of Elk Creek and Ox Bow Creek in the central part of the county. Geary soils formed in loess of the Loveland Formation.

Water-deposited sand and gravel of Pleistocene age occurs as a heterogeneous mixture. This material underlies the Loveland Loess along the north side of the Little Blue River and also along the lower side slopes of several large drainage tributaries on the north side of the Republican River. Meadin and Jansen soils have underlying material that is mixed sand and gravel.

The extent of limestone bedrock in Nuckolls County is limited. Almost all areas where limestone is near the surface are south of the Republican River Valley. Chalky limestone of the Niobrara Formation is the parent material of Kipson soils.

Climate

Climate is an active factor in the formation of soils. Its influence is both direct and indirect. It affects the weathering and reworking of soil material directly through rainfall, temperature, and wind.

Water received as rainfall moves through the drainageways, continually shifting, sorting, and reworking unconsolidated material of all kinds. The sediment is deposited, picked up, and redeposited many times by flowing streams. The alluvial soils in this county formed in water-deposited sediment. Water movement through the soil has also carried clay particles from the surface to the subsoil. The depth to calcium carbonate and the amount of clay in the subsoil have been modified by the water movement in the extensive areas of loess soils.

Alternate freezing and thawing hasten mechanical weathering of parent material. Summer heat and humidity speed chemical weathering. Kipson soils, which derived from limestone, formed through mechanical and chemical weathering of bedrock.

Wind transfers soil material from one place to another. The extensive deposit of Peoria Loess in this county is an example of the importance of wind as an agent of deposition of soil material. Holder, Hastings, and Uly soils formed in wind-deposited material.

Climate affects the soils indirectly through its effect on the kind and extent of vegetative cover and the kind of animal life. The main source of the organic matter in a soil is vegetation. Animals that live in the soil help in converting dead leaves, stems, roots, and other plant remains to organic matter. Burrowing animals help in mixing the various layers of soil.

The climate of Nuckolls County is characterized by moderately long and cold winters, cool springs and considerable precipitation, warm summers and many thunderstorms, and mild autumns and occasional rainy periods. The climate is fairly uniform throughout the county, and differences in the soils from one part of the county to another cannot be attributed to differences in climate. There are wide seasonal variations in temperature and in the amount of rainfall. The temperature commonly falls below 0°F in winter and soars to over 100° in summer. The annual average precipitation is about 25 inches.

Plant and animal life

The native plants in Nuckolls County were mainly tall, mid, and short grasses. This kind of vegetation provides an abundant supply of organic matter that affects the physical and chemical properties of soil. The fibrous roots of these grasses penetrate the soil, make it porous, and promote granular structure. The decay of organic matter over long periods results in a dark surface layer.

The number and kinds of micro-organisms are important in soil formation. The undecomposed organic matter in the soil is food for the living organisms. These living organisms change the organic matter into humus from which plants can obtain nutrients for better growth. The action of bacteria and various kinds of fungi causes leaves and other forms of organic matter to decay. Earthworms and small burrowing animals mix humus with the soil.

Man has a great effect on plant and animal life through his management of the soil. The kind of management determines whether the soil is conserved or is lost through erosion, whether fertility is maintained, and what kind of vegetation is dominant. Man affects the future rate of soil formation through his control of runoff and his management of cultivated soils.

Relief

The slope of soils in Nuckolls County ranges from nearly level to steep. Relief influences the formation of soils, mainly by controlling the movement of water on the surface. Relief, along with soil permeability, greatly affects runoff and internal drainage.

Uly silt loam, 11 to 30 percent slopes, for example, has less distinct horizons, a thinner solum, and a lighter colored surface layer than Holder silt loam, 6 to 11 percent slopes. Less moisture is available for plant growth and microbiological activity in the steeper soils because more of the rainfall runs off the surface.

Generally, nearly level and very gently sloping soils have a thick surface layer and subsoil. Much of the rainfall soaks into these soils, increasing plant growth, biological activity, and the rate of soil formation. For these reasons, the subsoil is thicker and finer textured in Crete silt loam, 0 to 1 percent slopes, for example, than in Hastings silt loam, 3 to 6 percent slopes.

Soils in depressions, such as Fillmore silt loam and Scott silt loam, are poorly drained and have a clayey subsoil that shows distinct evidence of soil formation. Soils on low bottom land are subject to overflow for short periods. Additional soil material and debris are deposited by each overflow. Decay of the organic matter is slower in these soils than in well drained soils. Hobbs and Cass soils are subject to overflow.

Time

The time required for a soil to form depends largely on the parent material. The finer the texture of the parent material, the longer the time needed for soil formation. The finer texture retards the downward movement of water, which is necessary in the process of soil formation. Soils that form in material weathered from exposed limestone take a long time. An example is Kipson soils.

The youngest soils in Nuckolls County formed in recently deposited alluvium. Except for a darkened surface layer, they show little or no evidence of soil formation because they have been in place for only a short time. Hobbs and McCook soils are examples of young soils. Hord soils formed in alluvium on high stream terraces and are intermediate in age. They have a subsoil that is in the beginning stages of formation.

The oldest soils of the county, which are on uplands, have been in place long enough to form genetic horizons that are fairly thick. The texture of the subsoil is finer than that of the parent material. Holder, Hastings, and Crete are examples of soils that have a distinct subsoil.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to management. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are assigned to broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*4, 7*).

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. The same property or subdivisions of this property may be used in several different categories. In table 8 the soil series of Nuckolls County are assigned

TABLE 8.—*Soils classified according to the current system of classification*

Series	Family	Subgroup	Order
Butler	Fine, montmorillonitic, mesic	Abruptic Argiaquolls	Mollisols.
Cass	Coarse-loamy, mixed, mesic	Fluventic Haplustolls	Mollisols.
Cozad	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Crete	Fine, montmorillonitic, mesic	Pachic Argiustolls	Mollisols.
Fillmore	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Geary	Fine-silty, mixed, mesic	Udic Argiustolls	Mollisols.
Gibbon	Fine-silty, mixed (calcareous), mesic	Fluvaquentic Haplaquolls	Mollisols.
Hall	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Hastings	Fine, montmorillonitic, mesic	Udic Argiustolls	Mollisols.
Hobbs	Fine-silty, mixed, nonacid, mesic	Mollic Ustifluvents	Entisols.
Holder	Fine-silty, mixed, mesic	Udic Argiustolls	Mollisols.
Hord	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Inavale	Sandy, mixed, mesic	Typic Ustifluvents	Entisols.
Jansen	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Udic Argiustolls	Mollisols.
Kipson	Loamy, mixed, mesic, shallow	Udorthentic Haplustolls	Mollisols.
McCook	Coarse-silty, mixed, mesic	Fluventic Haplustolls	Mollisols.
Meadin	Sandy-skeletal, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Munjor	Coarse-loamy, mixed (calcareous), mesic	Typic Ustifluvents	Entisols.
Scott	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Uly	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Wann [1]	Coarse-loamy, mixed, mesic	Fluvaquentic Haplustolls	Mollisols.

[1] Wann soils in this survey are taxadjuncts to the series because they are browner and have more very fine sand in the control section than is defined as the range for the series.

to three categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. Three exceptions to this are the Entisols, Histosols, and Vertisols, which occur in many different climates. Each order is identified by a word of three or four syllables ending in *sol* (Moll-i-sol).

SUBORDER. Each order is divided into suborders according to those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders are more narrowly defined than are the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of a water table near the surface; soil climate; the accumulation of clay, iron, or organic carbon in the upper part of the solum; cracking of soils caused by a decrease in soil moisture; and fine stratification. Each suborder is identified by a word of two syllables. The last syllable indicates the order. An example is Ustoll (*Ust*, meaning usually dry, and *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of soil horizons and features. The horizons used to make separations are those in which clay, carbonates, and other constituents have accumulated or have been removed and those that have pans that interfere with growth of roots, movement of water, or both. The features used are soil acidity, soil climate, soil composition, and soil color. Each great group is identified by a word of three or four syllables; a prefix is added to the name of the suborder. An example is Haplustoll (*Hapl*, meaning simple horizons, *ust*, usually dry, and *oll*, from Mollisols).

SUBGROUP. Each great group is divided into subgroups, one representing the central (typic) segment of the group, and others called intergrades, which have properties of the group and also one or more properties of another great group, suborder, or order. Other subgroups have soil properties unlike those of any other great group, suborder, or order. Each subgroup is identified by the name of the great group preceded by one or more adjectives. An example is Typic Haplustoll (a typical Haplustoll).

FAMILY. Soil families are established within a subgroup mainly on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, soil depth, and consistence. A family name is the subgroup name preceded by a series of adjectives, class names for texture and mineralogy, for example, that are used as family differentiae (see table 8). An example is the fine-silty, mixed, mesic family of Typic Haplustolls.

Physical and Chemical Analysis

Samples from soil profiles were collected for mechanical and chemical analysis by the Soil Conservation Service, Soil Survey Laboratory, in Lincoln, Nebraska. Hastings, Hall, Hord, and Crete soils were sampled in nearby counties. These data are recorded in Soil Survey Investigations Report Number 5 (*8*).

This information is useful to soil scientists in classifying soils and developing concepts of soil genesis. It is also helpful in estimating available water capacity, soil blowing, fertility, and tilth.

Environmental Factors Affecting Soil Use

On the pages that follow is information on the geology of the county; the physiography, relief, and drainage; the climate, water supply, and natural resources; the industry; the community, cultural, and recreational facilities; the transportation and markets; and trends in farming.

Geology

Shale and chalk of Late Cretaceous age are the principal bedrock exposures in Nuckolls County (*3*). The Carlile Shale, the oldest formation exposed, is on the south side of the Republican River along the valley wall and on the bottoms of drainage tributaries. The overlying Niobrara Formation is massive limestone and interbedded chalky shale. The Niobrara crops out on the lower slopes of drainageways on both sides of the river in the south-central part of the county. Kipson soils formed in this material.

The Ogallala Formation of Tertiary age unconformably overlies the Upper Cretaceous bedrock. It is not exposed on the surface in Nuckolls County.

The early Pleistocene age deposits of coarse sand and gravel unconformably overlie deposits of Cretaceous and Tertiary age. They are principally of cross bedded pebbly coarse sand and a few lenticular beds of silt and clay. The middle Pleistocene age deposits are silts and clays that locally grade downward into coarse sand and gravel. Meadin and Jansen soils formed over this sand and gravel. The latter deposits of Pleistocene age are wind-deposited silts that unconformably overlie other material throughout much of the county. They are the loess of the Loveland and Peoria Formations. The Loveland Loess has higher sand content and is the older of the two formations. The thickness of the Loveland Loess ranges from 5 to 40 feet. The Peoria Loess ranges from 3 to 20 feet thick and is the most common parent material of soils in Nuckolls County.

Recent deposits include alluvium of silts and sands that was deposited on flood plains. Alluvium of an older age has been deposited on the stream terraces. In places it is mixed with loess.

Physiography, Relief, and Drainage

Nuckolls County is part of a large ancient upland plain. It is divided into the Plains Border section and the High Plains section of the Great Plains physiographic province. The High Plains section is characterized by a moderately rolling surface of low relief

in the northeastern part of the county. This flat upland surface of the High Plains slopes eastward at a gradient that averages about 8 feet per mile. The Plains Border section is characterized by a deeply dissected topography of moderate relief and eastwardly slope. It occurs in the rest of the county, except for the valleys of the major streams.

The average elevation of Nuckolls County is about 1,800 feet above sea level. The general slope is southeastward. The uplands in the northwestern part reach a maximum elevation of slightly more than 1,900 feet and those in the southeastern part slightly less than 1,700 feet.

The Republican and Little Blue Rivers are the principal streams in the county. The flood plains of both these rivers, as well as some of their tributaries, are flanked by stream terraces along the valley walls. The Republican, the larger of the two rivers, flows eastward across the southern part of the county and has a gradient of 7 feet per mile. East and south of Superior the river bends southeast and flows into Kansas.

The Little Blue River flows southeasterly across the northeastern part of Nuckolls County and has a gradient of about 8 feet per mile. It flows throughout the year.

Dry Creek, Big Sandy Creek, Spring Creek, and Elk Creek are large intermittent drainageways. Narrow bottoms of flood plains and stream terraces are along their lower courses. Numerous smaller creeks flow toward the Republican and Little Blue Rivers.

Climate [7]

Nuckolls County is in south-central Nebraska and is bordered on the south by Kansas. The climate is typical of that near the center of a large continent. Summers are warm, and winters are cold. Rainfall is moderate and highly variable in amount. There are no large bodies of water nearby that have a noticeable influence on the climate.

The absence of climatological barriers to the north and south permits rather large temperature changes as the wind shifts from southerly to northerly or from northerly to southerly. The changes are more pronounced in winter than in summer, when the large land mass to the north is warm and is no longer a source of very cold air. Air masses having their origin over the Pacific Ocean arrive in this survey area comparatively dry after being modified as they move over the Rocky Mountains. Nearly all the precipitation is carried in by warm, moist winds from the Gulf of Mexico or the Caribbean.

Table 9 shows probable dates of the first freeze in fall and the last freeze in spring. Table 10 gives data on temperature and precipitation for the survey area, as recorded at Nelson and Superior, Nebraska.

Normally more than three-fourths of the average annual precipitation falls during the growing season, April through September. Deviations from average annual precipitation are large. In 75 years of record at Superior, the driest year, 1934, had only 10.64 inches of precipitation, compared to 48.76 inches in 1973, the wettest year.

Precipitation is generally light in winter; most of it falls as snow. On some occasions the precipitation begins as rain and changes to snow. Slow, steady rains characterize the early spring precipitation. Nearly all the summer precipitation occurs as showers and thundershowers. In the fall, thunderstorm activity commonly decreases rapidly. Nearly every winter has one or more periods of freezing rain.

Sharp temperature changes are frequent in winter. They are less frequent in summer, but days with high temperatures are often interspersed with cooler days. A period of 15 or more successive days when highs are in the 90's is not unusual.

The highest recorded temperature since 1935 is 116°F on July 25, 1940, at Nelson. The lowest recorded

[7] Prepared by climatology office, Conservation and Survey Division, University of Nebraska.

TABLE 9.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data interpolated from nearby stations for period 1921–70[1]]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	April 6	April 14	April 21	May 4	May 17
2 years in 10 later than	March 31	April 8	April 15	April 29	May 12
5 years in 10 later than	March 21	March 29	April 5	April 18	May 1
Fall:					
1 year in 10 earlier than	October 30	October 23	October 14	October 3	September 24
2 years in 10 earlier than	November 5	October 28	October 19	October 9	September 29
5 years in 10 earlier than	November 16	November 7	October 29	October 19	October 8

[1] All freeze data are based on temperatures measured in a standard National Weather Service thermometer shelter; the thermometers are placed approximately 5 feet above the ground; the exposure is believed representative of the surrounding area. Lower temperatures occur at times nearer the ground and in local areas subject to extreme air drainage on calm nights.

TABLE 10.—*Temperature and precipitation*

[Data from Nelson and Superior, Nebr.]

Month	Temperature				Precipitation				
	Average daily maximum[1]	Average daily minimum[1]	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than[2]	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than[2]	Average monthly total[3]	One year in 10 will have— Equal to or less than[4]	One year in 10 will have— Equal to or more than[4]	Days with 1 inch or more snow cover[5]	Average depth of snow on days with snow cover[5]
	°F	°F	°F	°F	Inches	Inches	Inches		Inches
January	36	13	57	−6	0.7	0.1	1.2	12	4
February	42	19	63	−1	.9	.1	1.7	9	4
March	51	26	74	7	1.7	.2	2.5	6	5
April	65	39	83	24	2.3	.4	3.8	1	2
May	75	50	90	37	3.9	1.2	6.3	0	------------
June	84	60	100	49	4.6	1.9	7.7	0	------------
July	89	64	103	56	3.5	1.0	7.6	0	------------
August	89	63	102	54	3.1	.7	5.9	0	------------
September	79	53	97	38	3.9	.6	5.9	0	------------
October	69	41	86	27	1.6	.2	3.9	(6)	2
November	52	28	71	13	1.2	(7)	2.3	2	3
December	40	18	59	−1	.8	(7)	1.8	7	4
Year	64	40	[8] 104	[9] −14	28.2	17.6	35.5	37	3

[1] Average daily maximum and minimum temperatures based on period 1944–73; from Nelson 1944 through October 1964, from Superior November 1964 through 1973.
[2] Probable 4-day temperature data interpolated from computer study 1931–63, from surrounding stations.
[3] Based on data from Nelson 1944–64, from Superior 1965–73.
[4] Probable total precipitation data based on data from Superior 1879–1973.
[5] Snow cover data interpolated from surrounding stations for period 1937–66.
[6] Less than 0.5 day.
[7] Trace.
[8] Average annual maximum.
[9] Average annual minimum.

since 1935 is —24° on January 4, 1959, also at Nelson. The average date of the last 32° temperature in spring is May 1. The average date of the first 32° temperature in the fall is October 8.

Annual evaporation from small lakes and farm ponds averages 52 inches, and about 75 percent of that amount occurs during the period May through October.

Water Supply

The area north of the Little Blue River has an adequate supply of good quality ground water for irrigation, domestic use, and livestock. Ground water for domestic use and livestock is available in the east-central and southeastern parts of Nuckolls County. A limited number of irrigation wells are in the east-central and southeastern parts.

The bottom land along the Little Blue River and the Republican River Valley has a plentiful supply of ground water for domestic use and for livestock. The lack of coarse sand and gravel in this area limits the quantity of water available for irrigation wells.

Water for domestic use and livestock is not always readily available in the part of Nuckolls County that is underlain by chalky limestone bedrock. In these areas infiltration is poor and much of the ground water drains off by natural discharge from springs along the hillsides and bottoms of drainageways.

In July 1974, there were 370 irrigation wells in Nuckolls County. These were used to irrigate 50,000 acres. Water from the Bostwick Irrigation District was used to irrigate 7,200 acres in 1974. This water is from a reservoir above an upstream dam on the Republican River in Harlan County, Nebraska. Streams and ponds provide irrigation water for 5,600 acres. There are 12 municipal wells and 2 industrial wells in the county.

Natural Resources

Soils and water are important natural resources in Nuckolls County. The soils are suited to a wide variety of crops and other farm enterprises. The friable soils of the Republican River Valley are well suited to irrigation. The water is delivered through canals of the Bostwick Irrigation District. The topography in the uplands is well suited to gravity irrigation if an adequate supply of ground water is available. Irrigation water from wells and the canals is generally of good quality. Sand and gravel for roadbuilding and improvement is available from pits along the valleys and tributaries of the Little Blue River and the Republican River.

Industry

Small industries have been established in Nuckolls County. Those associated with farming are the processing of produce for dairy cattle, feed milling, and the

dehydration of alfalfa. One of the large industrial plants is the cement plant at Superior. The limestone resources for this plant are mined across the State line in Jewel County, Kansas. Other industries in the Superior area are bottling of soft beverages, machine shops, a gasoline terminal, livestock auctions, a radio station, and a television station.

Recreational Facilities

Outdoor recreation is provided at Lovewell Reservoir, 10 miles south of Superior. The facilities include a marina, camping areas, picnic shelters, trailer parks, boat ramps, club sites, and cabins. The lake is 6 miles long and has a 44-mile shoreline. The Republican River and the Little Blue River provide water for recreation. The large number of farm ponds in the upland areas provide hunting of migratory waterfowl and fishing for sportsmen. Golf courses and city parks are in or near the communities of Superior, Nelson, and Lawrence.

Transportation and Markets

Several railroads crossing the county furnish rail transportation. Nebraska Highway No. 4 crosses the northern part of the county in an east-west direction. Nebraska Highway No. 8 extends from Superior east across the southern part of the county. The north-south Nebraska Highway No. 14 and the east-west U.S. Highway No. 136 cross the central part of the county. Gravel roads are on most section lines, except along bottom land areas and in areas having rough topography. Bus service is available in Nelson and Superior.

Most of the corn, grain sorghum, and wheat grown in the county is marketed at local elevators. It is transported by rail and truck to larger terminal markets. Some grain is fed locally to livestock in feedlots. Nearly all livestock is shipped to the larger markets outside the county. Many of the poultry and dairy products are marketed in local communities, although some are shipped directly to larger markets.

Trends in Farming

Farming has been the most important enterprise in Nuckolls County since the county was settled. In the early years, crops were used only for local consumption. When grain elevators and railroads made other markets available, production of crops and livestock increased.

Growing crops under high level management and conserving soil and water have helped to advance farming in Nuckolls County. Among the recent trends are use of new and improved crop hybrids; commercial fertilizer; chemicals to control weeds and insects; larger, more efficient machinery; use of improved methods of tillage; and irrigation water from canals and deep wells.

The 1968 Conservation Needs Inventory shows the trends in land use since 1958. In 1968, there were 229,500 acres in cropland, about 5,000 less than in 1958. Acres under irrigation increased during this same period from 24,335 to 46,821 acres. The irrigated acreage has continued to increase in recent years. In 1968, about 109,700 acres was in range and pasture, about 9,000 acres more than in 1958. Seeding the steeper and more eroded areas to native grasses has been a continuing trend since the early 1950's. The 10,600 acres of woodland has remained about the same during this period. The rest of the acreage, which includes roads, homes, lots, and wasteland, decreased from 12,200 to 7,500 acres.

Grain sorghum, wheat, corn, and alfalfa are the principal crops grown in Nuckolls County. The Nebraska Agriculture Statistics Annual Report shows the harvested acreage of grain sorghum decreased from 56,912 areas in 1964 to 54,426 in 1969. Acreage of wheat decreased from 44,826 acres in 1964 to 40,308 acres during the same period. In 1964, about 22,644 acres of corn was harvested, and this increased to 27,659 in 1969. The acreage of hay decreased from 21,478 acres in 1964 to 14,284 in 1969.

Cattle are the principal livestock in Nuckolls County, but hogs, sheep, and chickens are also important. The Nebraska Agriculture Statistics Annual Report listed the following number of livestock on farms as of January 1, 1969, as compared to 1964. In 1969, there were 57,932 cattle in the county. This is about 3,000 more than in 1964. The number of hogs was 37,770 in 1969. This was an increase of about 6,000 since 1964. In 1969, there were 1,469 sheep, which was a decrease of 3,400 since 1964. The number of chickens was 24,599 in 1969. This was a decrease of about 50,000 since 1964.

Literature Cited

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vols., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Miller, Robert D., Richard Van Horn, Ernest Dobrovolny, and Lawrence P. Buck. 1964. Geology of Franklin, Webster, and Nuckolls Counties, Nebr. Geological Surv. Bull. 1165.

(4) Simonson, Roy W. 1962. Soil classification in the United States, Science vol. 137, 1027-1034.

(5) United States Department of Agriculture. 1925. Soil Survey of Nuckolls County, Nebr. 53 pp.

(6) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(7) United States Department of Agriculture. 1960. Soil classification, a comprehensive system, 7th approximation. Soil Conserv. Serv., 265 pp., illus. [Supplements issued March 1967, September 1968]

(8) United States Department of Agriculture. 1966. Soil survey laboratory data and descriptions for some soils of Nebraska. Soil Surv. Invest. Rep. 5, 233 pp.

Glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (ph 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The terms and inches of water recognized in this survey are as follows:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedrock. The soil rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse textured (light textured) soil. Sand or loamy sand.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concentrations is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Depth, soil. The total thickness of weathered soil material over mixed sand and gravel or bedrock. Depth classes recognized in this survey are:

	Inches
Very shallow	0 to 10
Shallow	10 to 20
Moderately deep	20 to 40
Deep	more than 40

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Exclusively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly previous. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Intake rate. The average rate at which water enters a soil under irrigation. The rate of water intake in inches per hour as used in this survey is as follows:

Less than 0.2	Very low
0.2 to 0.4	Low
0.4 to 0.75	Moderately low
0.75 to 1.25	Moderate
1.25 to 1.75	Moderately high
1.75 to 2.5	High
More than 2.5	Very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Organic matter (soil). Plant and animal residue at various states of decomposition. Commonly determined as the organic material that passes through a 2 millimeter sieve. The terms and percentages recognized in this survey are as follows:

Less than 0.5	Very low
0.5 to 1.0	Low
1.0 to 2.0	Moderately low
2.0 to 4.0	Moderate

Permeability. The quality that enables the soil to transmit water or air measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch), moderately slow (0.2 to 0.6 inch), moderate (0.6 to 2.0 inches), moderately rapid (2.0 to 6.0 inches), rapid (6.0 to 2.0 inches), and very rapid (more than 20 inches). In this survey, permeability applies to that part of the soil below the Ap, or equivalent layer, and above a depth of 60 inches, or to bedrock if it occurs within a depth of 60 inches.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—excellent, good, fair, and poor. The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such locations that growth of most crop plants is less than normal.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet or horizontal distance. The following slope classes are recognized in this survey:

0 to 1	Nearly level
1 to 3	Very gently sloping
3 to 6	Gently sloping
6 to 11	Strongly sloping
11 to 30	Steep

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops) blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

Map symbol	Mapping unit	Page	Dryland capability unit Symbol	Dryland capability unit Page	Irrigated capability unit Symbol	Irrigated capability unit Page	Range site Name	Windbreak suitability group Number
Bu	Butler silt loam, 0 to 1 percent slopes	9	IIw-2	31	IIw-2	38	Clayey	2
Ca	Cass loam, occasionally flooded, 0 to 2 percent slopes	10	IIw-3	32	IIw-8	39	Sandy Lowland	1
Co	Cozad silt loam, 0 to 1 percent slopes	11	I-1	31	I-6	38	Silty Lowland	1
Cr	Crete silt loam, 0 to 1 percent slopes	12	IIs-2	32	IIs-2	39	Clayey	4
Fm	Fillmore silt loam, 0 to 1 percent slopes	12	IIIw-2	33	IIIw-2	41	Clayey Overflow	6
Fo	Fillmore silt loam, drained, 0 to 1 percent slopes	12	IIw-2	31	IIw-2	38	Clayey	2
GaC	Geary silt loam, 3 to 6 percent slopes	13	IIIe-1	33	IIIe-4	40	Silty	4
GaD	Geary silt loam, 6 to 11 percent slopes	14	IVe-1	34	IVe-4	41	Silty	4
GeC2	Geary silty clay loam, 3 to 6 percent slopes, eroded	14	IIIe-8	33	IIIe-3	39	Silty	4
GeD2	Geary silty clay loam, 6 to 11 percent slopes, eroded	14	IVe-8	34	IVe-3	41	Silty	4
GfF	Geary complex, 11 to 30 percent slopes	14	VIe-1	35	------	--	Silty	10
GfF3	Geary complex, 11 to 30 percent slopes, severely eroded	14	VIe-8	35	------	--	Silty	10
GgC	Geary and Jansen silt loams, 3 to 6 percent slopes	15	IIIe-1	33	IIIe-7	40	Silty	--
	Geary part	--	------	--	------	--	------------	4
	Jansen part	--	------	--	------	--	------------	5
GhD2	Geary and Jansen soils, 6 to 11 percent slopes, eroded	15	IVe-8	34	IVe-7	42	Silty	--
	Geary part	--	------	--	------	--	------------	4
	Jansen part	--	------	--	------	--	------------	5
GhF	Geary and Jansen soils, 11 to 30 percent slopes	15	VIe-1	35	------	--	Silty	10
Gn	Gibbon silt loam, 0 to 1 percent slopes	16	IIw-4	32	IIw-6	39	Subirrigated	2
Ha	Hall silt loam, 0 to 1 percent slopes	16	I-1	31	I-4	37	Silty	4
Hb	Hall silt loam, terrace, 0 to 1 percent slopes	17	I-1	31	I-4	37	Silty Lowland	1
Hc	Hastings silt loam, 0 to 1 percent slopes	18	I-1	31	I-4	37	Silty	4
HcB	Hastings silt loam, 1 to 3 percent slopes	18	IIe-1	31	IIe-4	38	Silty	4
HcC	Hastings silt loam, 3 to 6 percent slopes	18	IIIe-1	33	IIIe-4	40	Silty	4
HdC2	Hastings silty clay loam, 3 to 6 percent slopes, eroded	18	IIIe-8	33	IIIe-3	39	Silty	4
HeB	Hobbs silt loam, channeled, 0 to 3 percent slopes	19	VIw-7	36	------	--	Silty Overflow	10

Map symbol	Mapping unit	Page	Dryland capability unit		Irrigated capability unit		Range site	Windbreak suitability group
			Symbol	Page	Symbol	Page	Name	Number
Hf	Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes---	19	IIw-3	32	IIw-6	39	Silty Overflow	1
HgB	Holder silt loam, 1 to 3 percent slopes--------------------------	20	IIe-1	31	IIe-4	38	Silty	4
HgC	Holder silt loam, 3 to 6 percent slopes--------------------------	20	IIIe-1	33	IIIe-4	40	Silty	4
HgD	Holder silt loam, 6 to 11 percent slopes--------------------------	20	IVe-1	34	IVe-4	41	Silty	4
HhC2	Holder silty clay loam, 3 to 6 percent slopes, eroded----------	20	IIIe-8	33	IIIe-3	39	Silty	4
HhD2	Holder silty clay loam, 6 to 11 percent slopes, eroded----------	21	IVe-8	34	IVe-3	41	Silty	4
Hr	Hord silt loam, 0 to 1 percent slopes-------------------------	21	I-1	31	I-6	38	Silty Lowland	1
HrB	Hord silt loam, 1 to 3 percent slopes-------------------------	21	IIe-1	31	IIe-6	38	Silty Lowland	1
HrC	Hord silt loam, 3 to 6 percent slopes-------------------------	21	IIIe-1	33	IIIe-6	40	Silty	4
Ig	Inavale loamy fine sand, 0 to 2 percent slopes------------------	22	IVe-5	34	IIIe-11	40	Sandy Lowland	3
In	Inavale fine sandy loam, 0 to 2 percent slopes------------------	22	IIIe-3	33	IIIe-11	40	Sandy Lowland	3
KsF	Kipson silt loam, 6 to 30 percent slopes-------------------------	23	VIs-4	36	-------	--	Shallow Limy	10
Ma	Marsh----------------------------	24	VIIIw-7	36	-------	--	-----------	10
Mb	McCook fine sandy loam, 0 to 2 percent slopes------------------	24	IIe-3	31	IIe-5	38	Silty Lowland	3
Mc	McCook silt loam, 0 to 1 percent slopes-------------------------	24	I-1	31	I-6	38	Silty Lowland	1
MdF	Meadin loam, 6 to 30 percent slopes-------------------------	25	VIs-4	36	-------	--	Shallow to Gravel	10
Mu	Munjor soils, 0 to 2 percent slopes-------------------------	26	IIIw-3	34	IIIw-8	41	Sandy Lowland	3
Sa	Saline-Alkali land----------------	26	VIs-1	35	-------	--	Saline Subirrigated	10
Sb	Sandy alluvial land---------------	26	VIIw-7	36	-------	--	-----------	10
Sc	Scott silt loam, 0 to 1 percent slopes-------------------------	27	IVw-2	35	-------	--	-----------	10
UyF	Uly silt loam, 11 to 30 percent slopes-------------------------	28	VIe-1	35	-------	--	Silty	10
UyF2	Uly silt loam, 11 to 30 percent slopes, eroded------------------	28	VIe-8	35	-------	--	Silty	10
Wb	Wann fine sandy loam, 0 to 2 percent slopes------------------	28	IIw-6	32	IIw-8	39	Subirrigated	2
Wm	Wann loam, 0 to 2 percent slopes---	29	IIw-4	32	IIw-8	39	Subirrigated	2

☆U.S. Government Printing Office: 1978—0—219-877

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

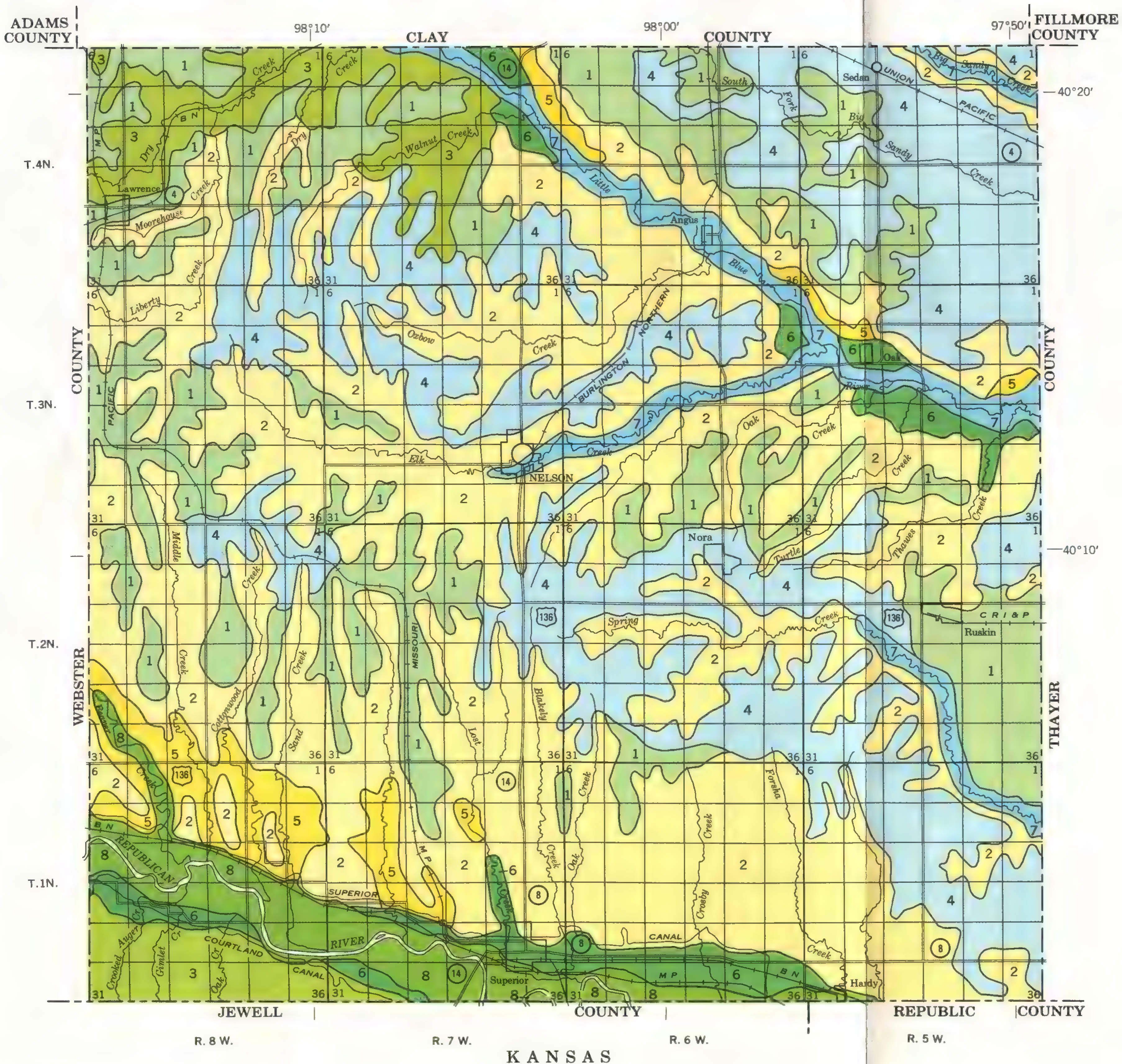
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP

NUCKOLLS COUNTY, NEBRASKA

Scale 1:190,080

1 0 1 2 3 4 Miles



Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SOIL ASSOCIATIONS*

1 — Hastings association: Deep, nearly level to gently sloping, well drained silty soils on loess uplands

2 — Geary-Hastings association: Deep, very gently sloping to steep, well drained silty soils on divides and side slopes of loess uplands

3 — Geary-Holder association: Deep, very gently sloping to steep, well drained silty soils on divides and side slopes of loess uplands

4 — Crete-Hastings association: Deep, nearly level to gently sloping, moderately well drained and well drained silty soils on loess uplands

5 — Geary-Jansen-Meadin association: Deep, gently sloping to steep, well drained silty soils and gently sloping to steep, well drained and excessively drained silty and loamy soils that are moderately deep and shallow over sand and gravel; on uplands

6 — Hord association: Deep, nearly level to gently sloping, well drained silty soils on stream terraces

7 — Hord-Cass-Hobbs association: Deep, nearly level, well drained and moderately well drained silty and loamy soils on bottom land and stream terraces

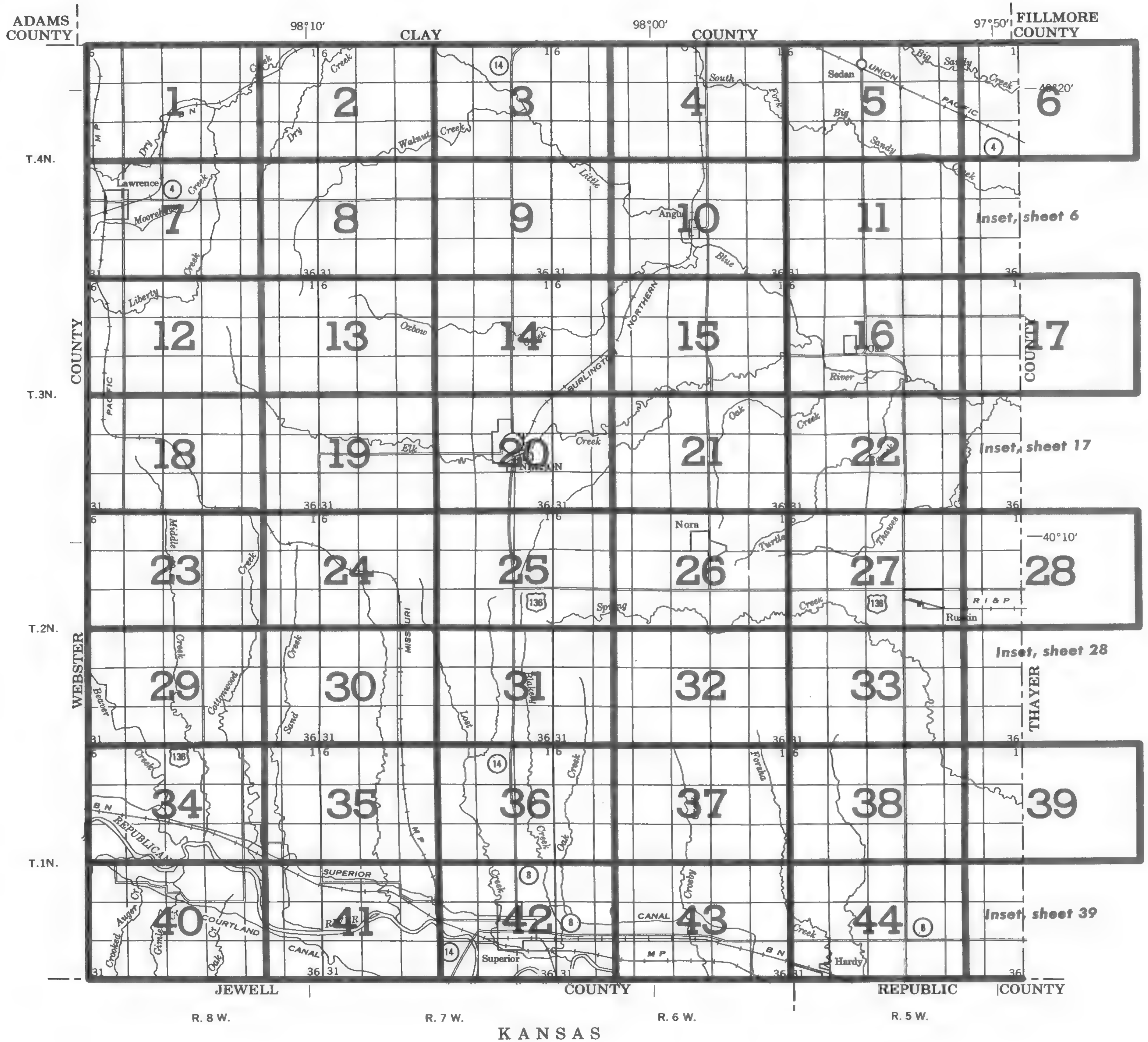
8 — McCook-Wann-Inavale association: Deep, nearly level, somewhat excessively drained to somewhat poorly drained silty, loamy, and sandy soils on bottom land

* The texture mentioned in the legends refers to the surface layer of the major soils unless otherwise noted.

Compiled 1977

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



INDEX TO MAP SHEETS

NUCKOLLS COUNTY, NEBRASKA

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The first capital letter is the initial one of the soil name. The lower case letter that follows separates mapping units having names that begin with the same letter except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are those soils with slope ranges of 0 to 1 percent or 0 to 2 percent slopes. A final number 2 or 3, indicates that the soil is eroded or severely eroded.

SYMBOL	NAME
Bu	Butler silt loam, 0 to 1 percent slopes
Ca	Cass loam, occasionally flooded, 0 to 2 percent slopes
Co	Cozad silt loam, 0 to 1 percent slopes
Cr	Crete silt loam, 0 to 1 percent slopes
Fm	Fillmore silt loam, 0 to 1 percent slopes
Fo	Fillmore silt loam, drained, 0 to 1 percent slopes
GaC	Geary silt loam, 3 to 6 percent slopes
GaD	Geary silt loam, 6 to 11 percent slopes
GeC2	Geary silty clay loam, 3 to 6 percent slopes, eroded
GeD2	Geary silty clay loam, 6 to 11 percent slopes, eroded
GfF	Geary complex, 11 to 30 percent slopes
GfF3	Geary complex, 11 to 30 percent slopes, severely eroded
GgC	Geary and Jansen silt loams, 3 to 6 percent slopes
GhD2	Geary and Jansen soils, 6 to 11 percent slopes, eroded
GhF	Geary and Jansen soils, 11 to 30 percent slopes
Gn	Gibbon silt loam, 0 to 1 percent slopes
Ha	Hall silt loam, 0 to 1 percent slopes
Hb	Hall silt loam, terrace, 0 to 1 percent slopes
Hc	Hastings silt loam, 0 to 1 percent slopes
HcB	Hastings silt loam, 1 to 3 percent slopes
HcC	Hastings silt loam, 3 to 6 percent slopes
HdC2	Hastings silty clay loam, 3 to 6 percent slopes, eroded
HeB	Hobbs silt loam, channeled, 0 to 3 percent slopes
Hf	Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes
HgB	Holder silt loam, 1 to 3 percent slopes
HgC	Holder silt loam, 3 to 6 percent slopes
HgD	Holder silt loam, 6 to 11 percent slopes
HhC2	Holder silty clay loam, 3 to 6 percent slopes, eroded
HhD2	Holder silty clay loam, 6 to 11 percent slopes
Hr	Hord silt loam, 0 to 1 percent slopes
HrB	Hord silt loam, 1 to 3 percent slopes
HrC	Hord silt loam, 3 to 6 percent slopes
Ig	Inavale loamy fine sand, 0 to 2 percent slopes
In	Inavale fine sandy loam, 0 to 2 percent slopes
KsF	Kipson silt loam, 6 to 30 percent slopes
Ma	Marsh
Mb	McCook fine sandy loam, 0 to 2 percent slopes
Mc	McCook silt loam, 0 to 1 percent slopes
MdF	Meadin loam, 6 to 30 percent slopes
Mu	Munjor soils, 0 to 2 percent slopes
Sa	Saline-alkali land
Sb	Sandy alluvial land
Sc	Scott silt loam, 0 to 1 percent slopes
UyF	Uly silt loam, 11 to 30 percent slopes
UyF2	Uly silt loam, 11 to 30 percent slopes, eroded
Wb	Wann fine sandy loam, 0 to 2 percent slopes
Wm	Wann loam, 0 to 2 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; w)

PITS

- Gravel pit (G.P.)
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; w)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CeA; FoB2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

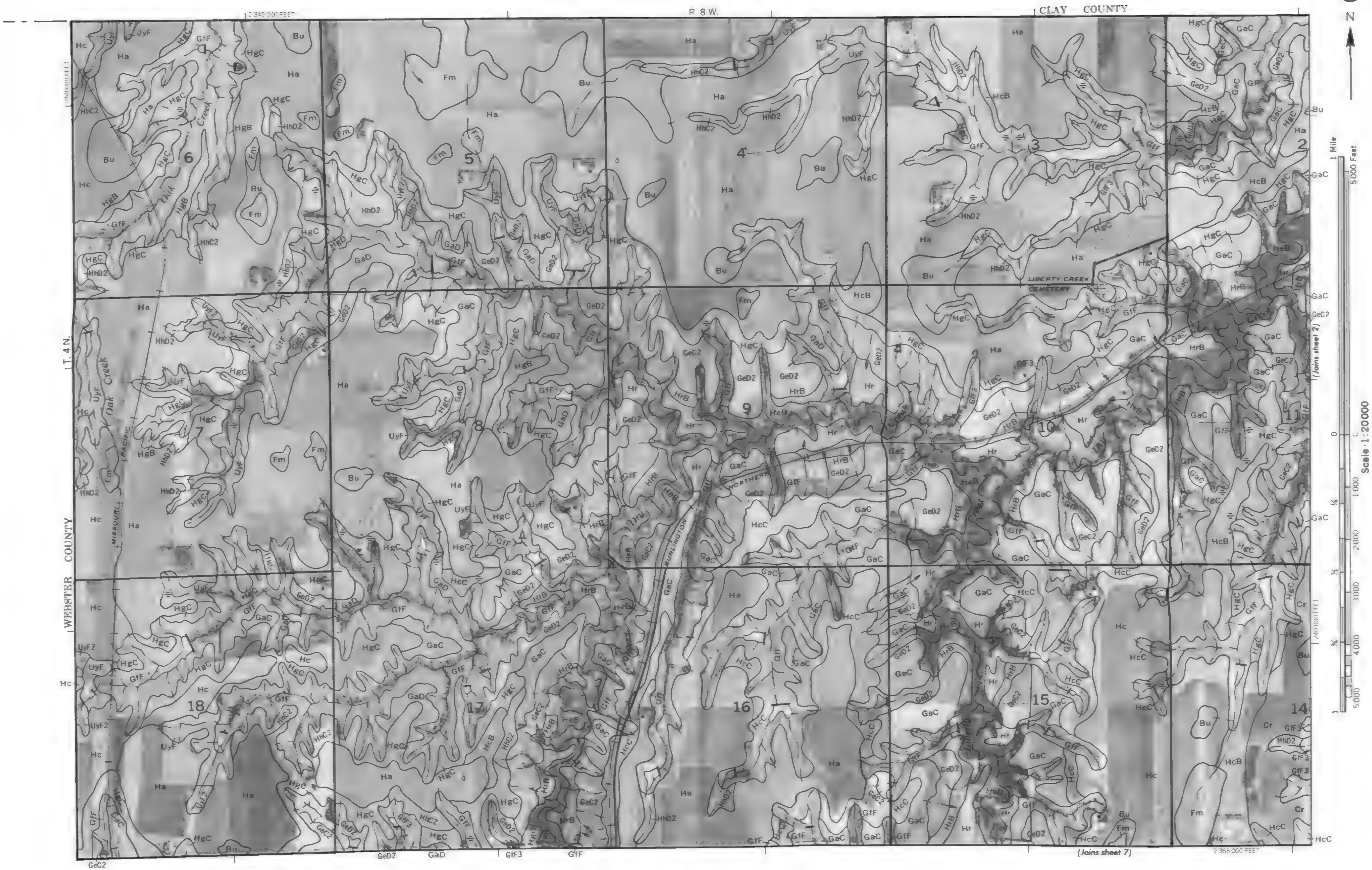
GULLY

DEPRESSION OR SINK

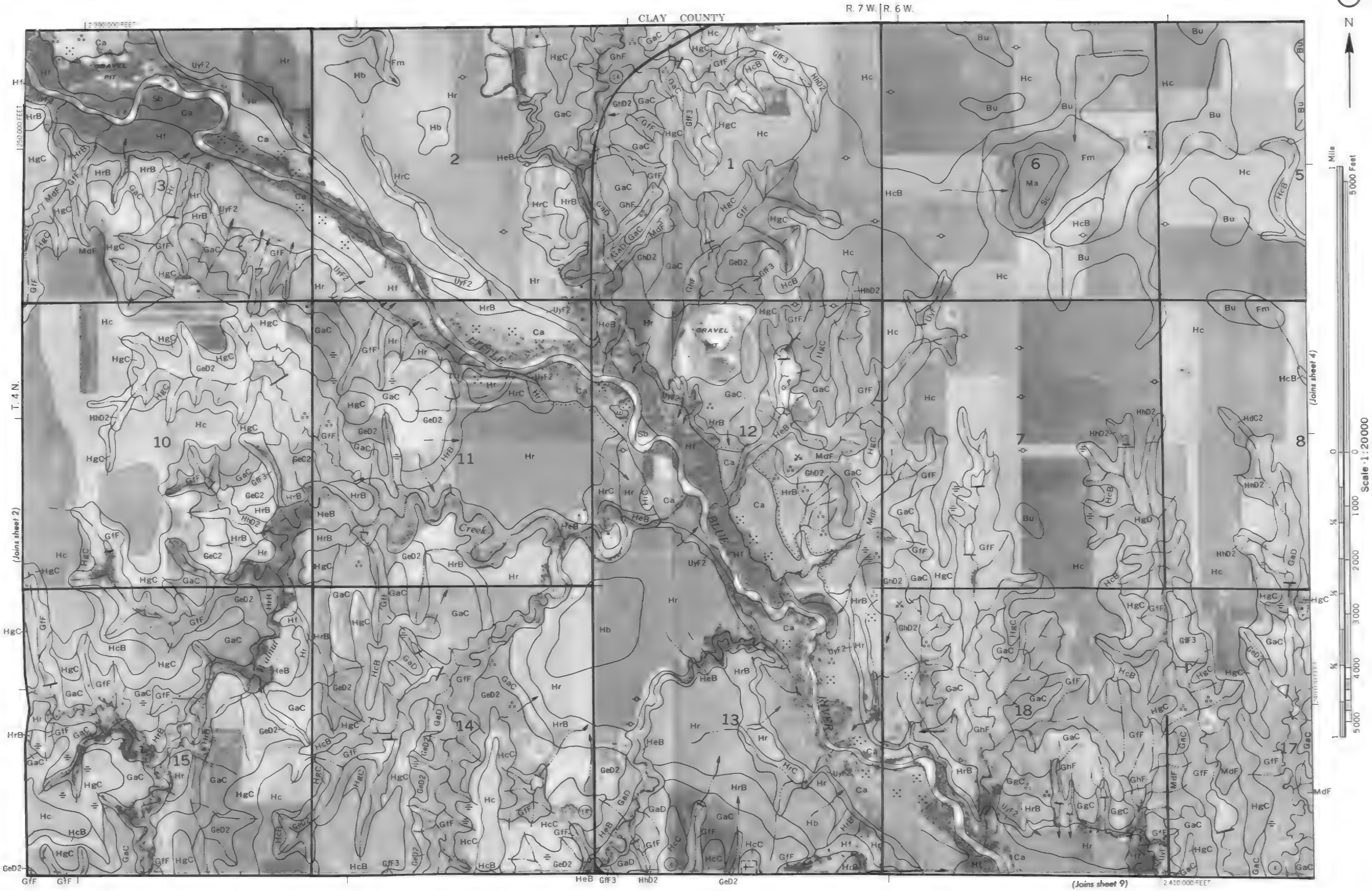
SOIL SAMPLE SITE (normally not shown)

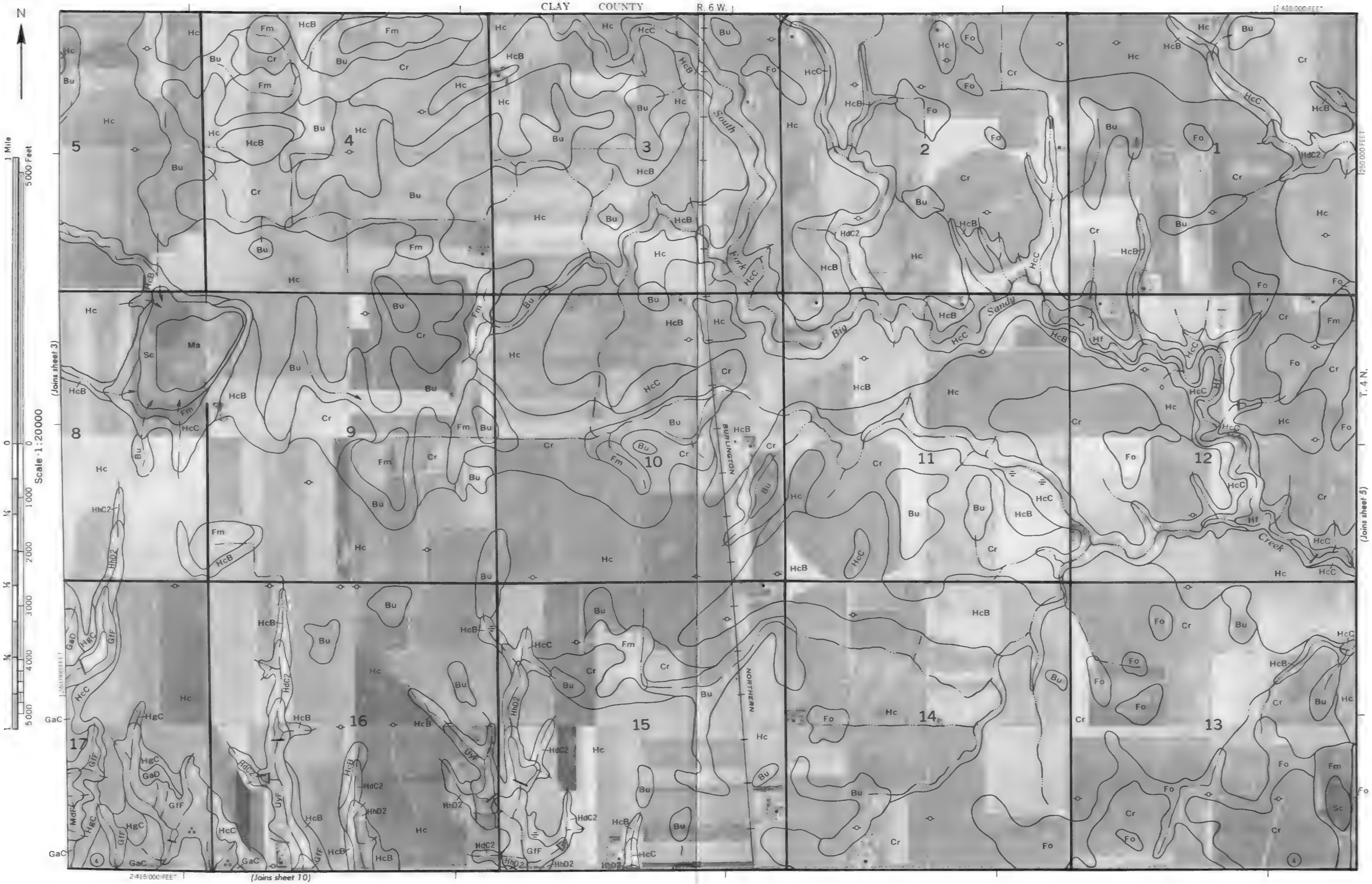
MISCELLANEOUS

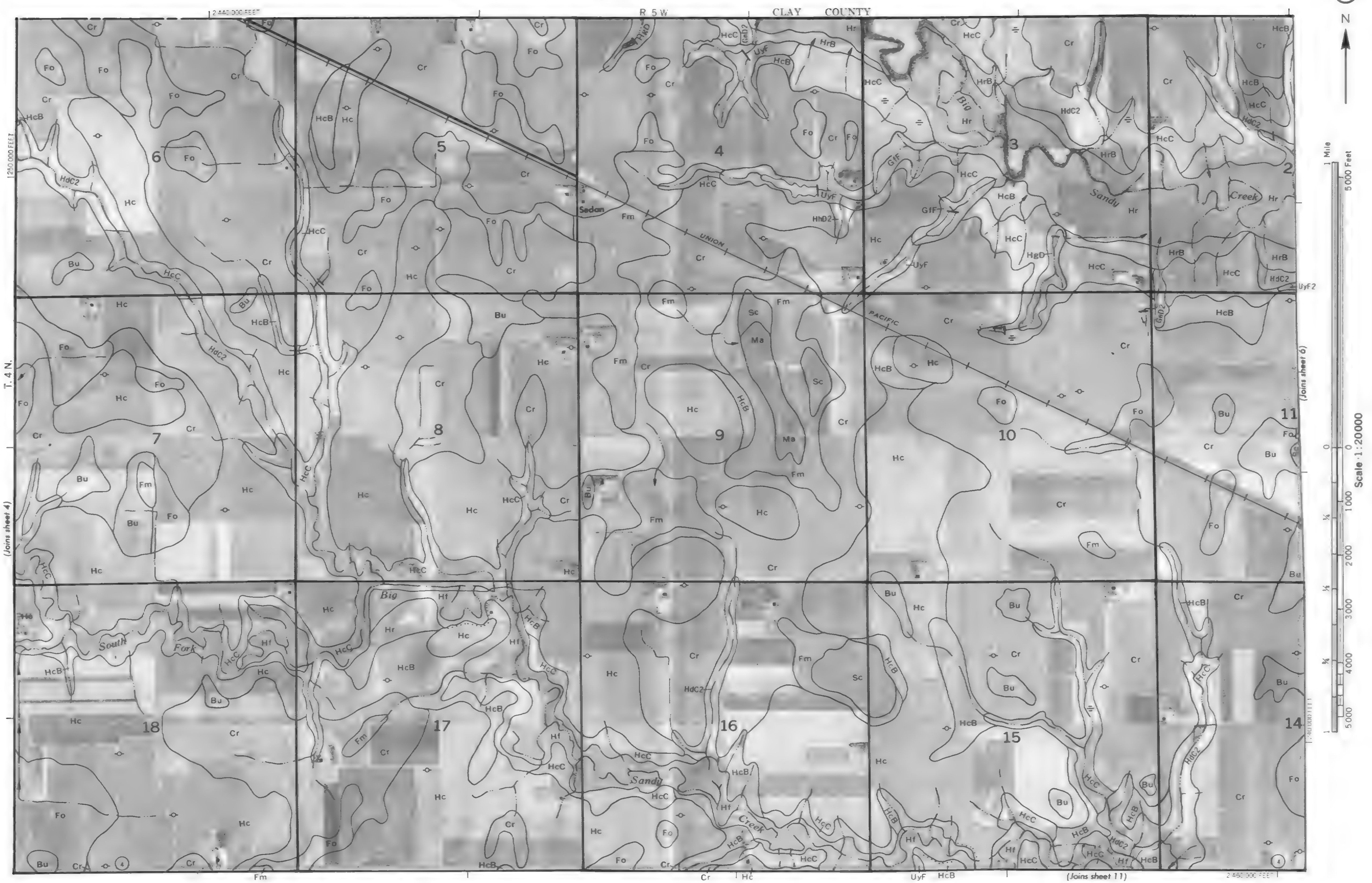
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot


1
N
CLAY COUNTY
R. 8 W.
T. 4 N.
WEBSTER COUNTY
Oak Creek
LIBERTY CREEK CEMETERY
Liberty Creek
MISSOURI PACIFIC
BURLINGTON NORTHERN
(Joins sheet 2)
(Joins sheet 7)
1 Mile
5000 Feet
Scale 1:20000
2 365 000 FEET
240 000 FEET

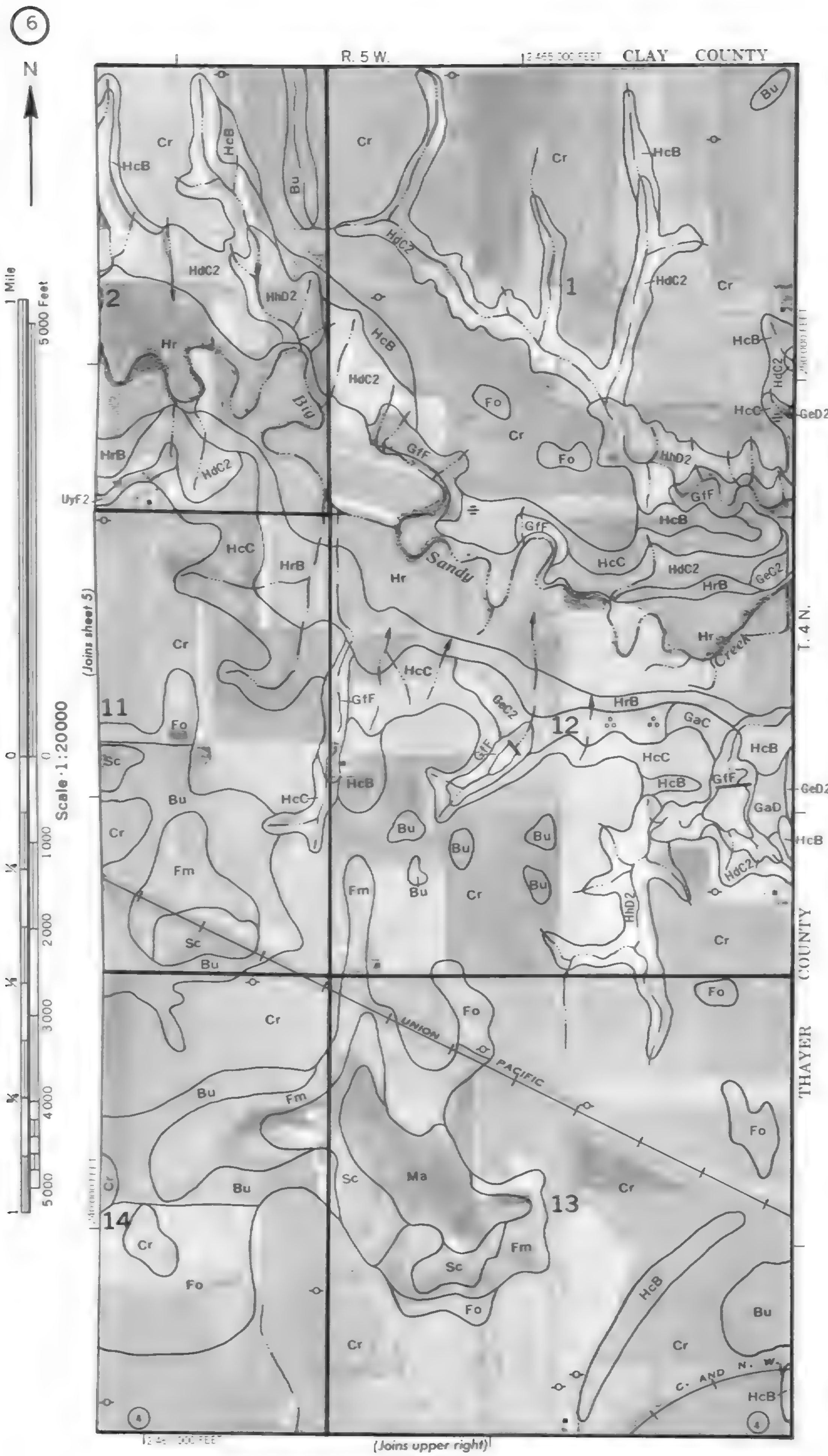

2
N
CLAY COUNTY
R. 8 W. | R. 7 W.
T. 4 N.
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 8)
Scale 1:20000
1 Mile
5000 Feet
BURLINGTON NORTHERN
Dry Creek
Walnut Creek
PLEASANT HILL CEMETERY
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18

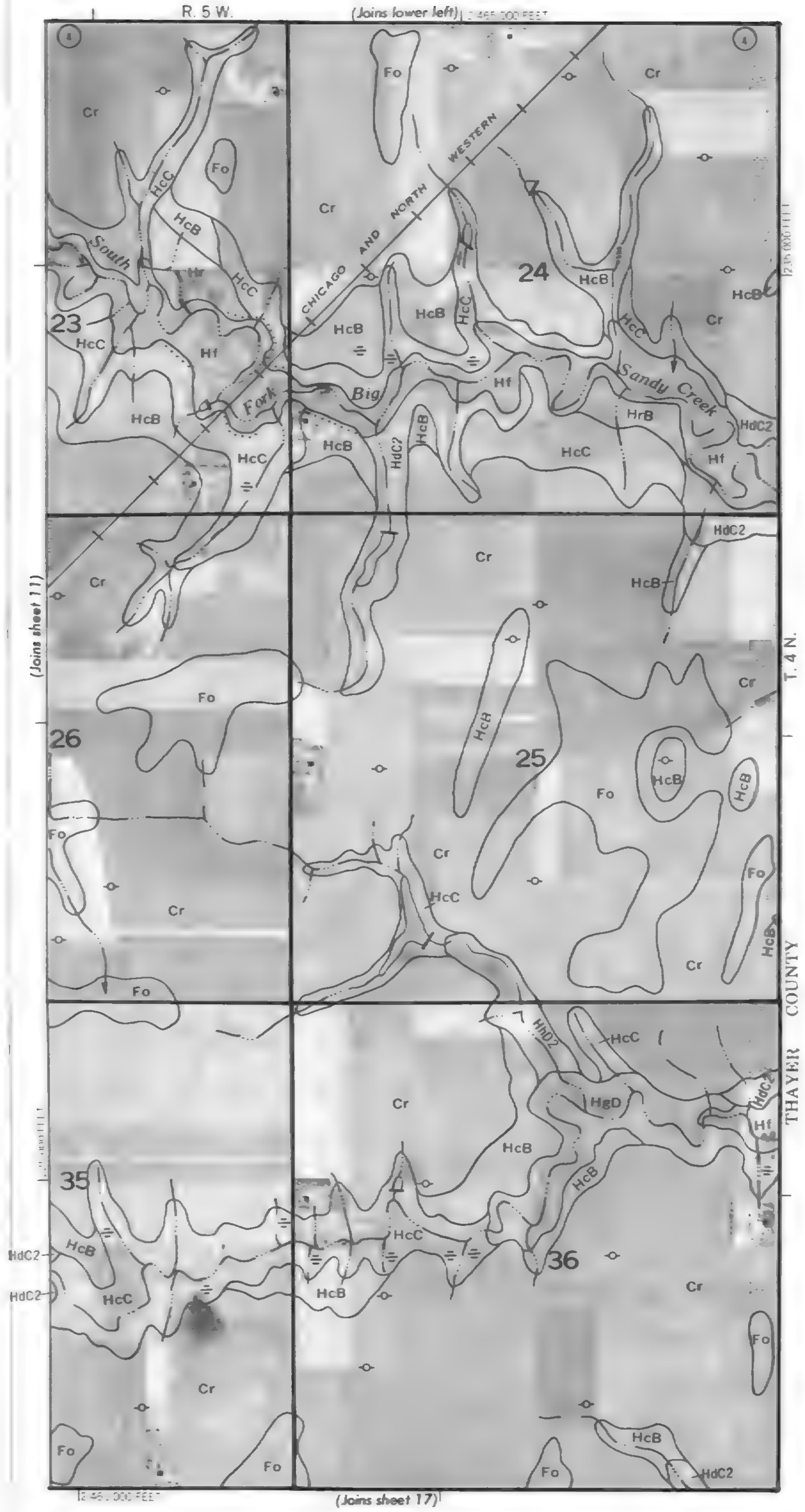

CLAY COUNTY
R. 7 W.
R. 6 W.
T. 4 N.
2 390 000 FEET
250 000 FEET
2 410 000 FEET
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 9)
GRAVEL PIT
GRAVEL
LITTLE BLUE RIVER
Creek
N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
½
¼
¾
1
2
3
4
5
6
7
8
10
11
12
13
14
15
17
18


N
CLAY COUNTY
R. 6 W.
T. 4 N.
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 10)
Scale 1:20000
1 Mile
5000 Feet
South Fork
Big Sandy Creek
BURLINGTON NORTHERN
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17



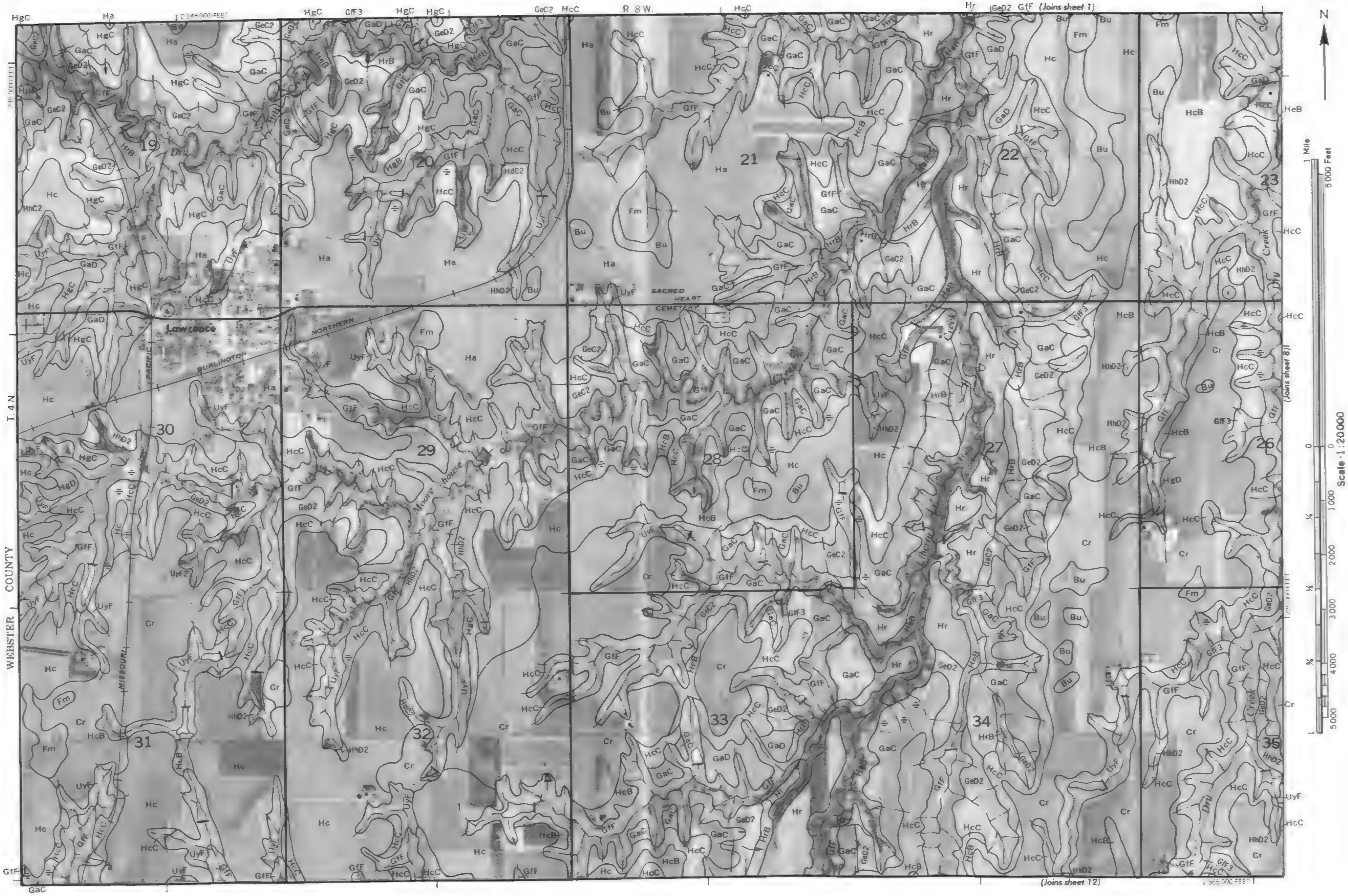
5
N
CLAY COUNTY
R 5 W
T. 4 N.
2 440 000 FEET
250 000 FEET
Sedan
UNION
PACIFIC
Big Sandy Creek
South Fork
Big
Sandy
Creek
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 11)
2 460 000 FEET
3
4
5
6
2
7
8
9
10
11
18
17
16
15
14
Cr
Fo
HcB
HcC
HdC2
Hc
Bu
Fm
Sc
Ma
Hr
HrB
GfF
UyF
UyF2
HgD
HhD2
Hf
Scale 1:20000
1 Mile
5000 Feet
0
¼
½
¾
1000
2000
3000
4000
5000



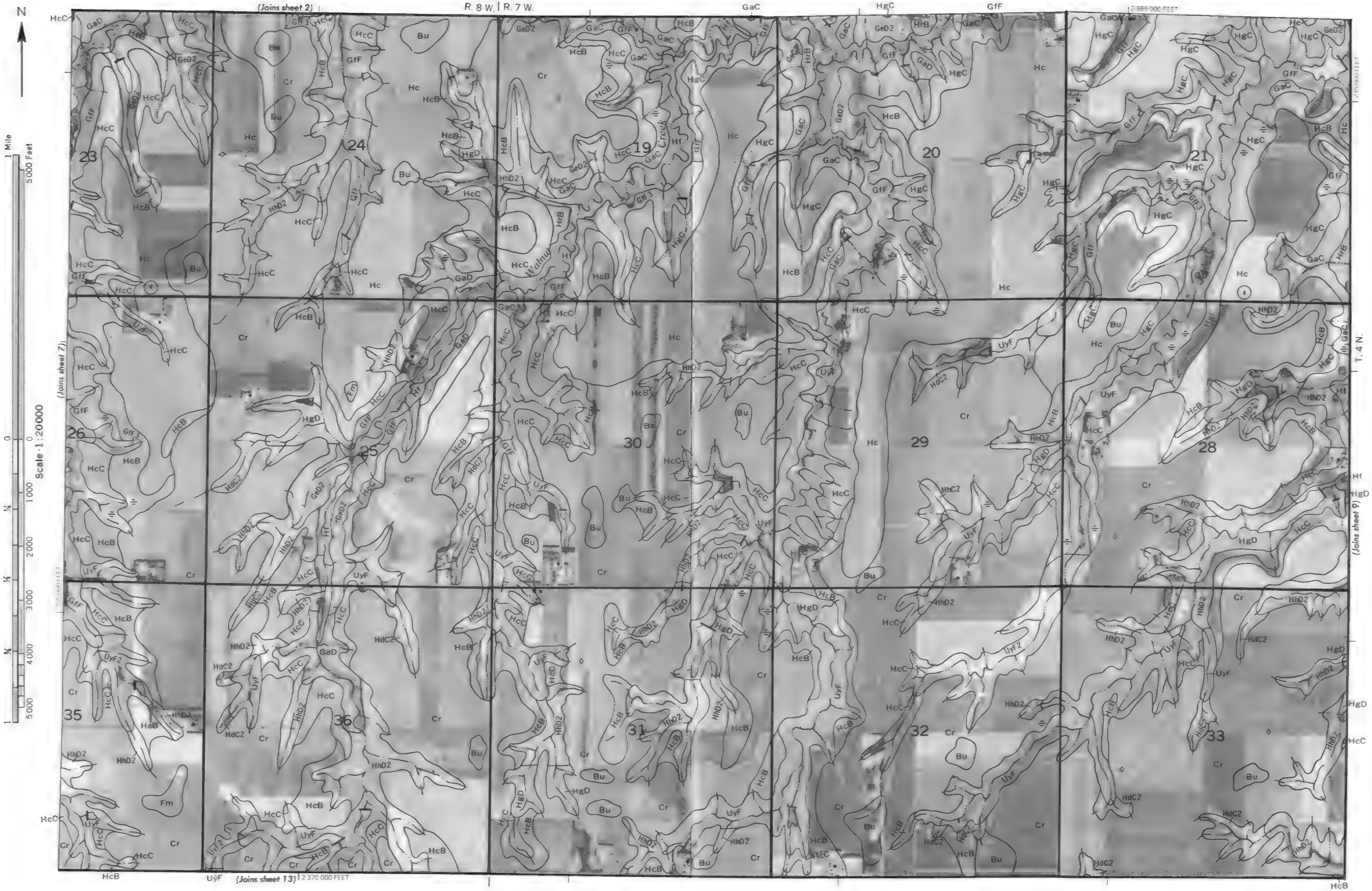


4000 AND 5000-FOOT GRID TICKS

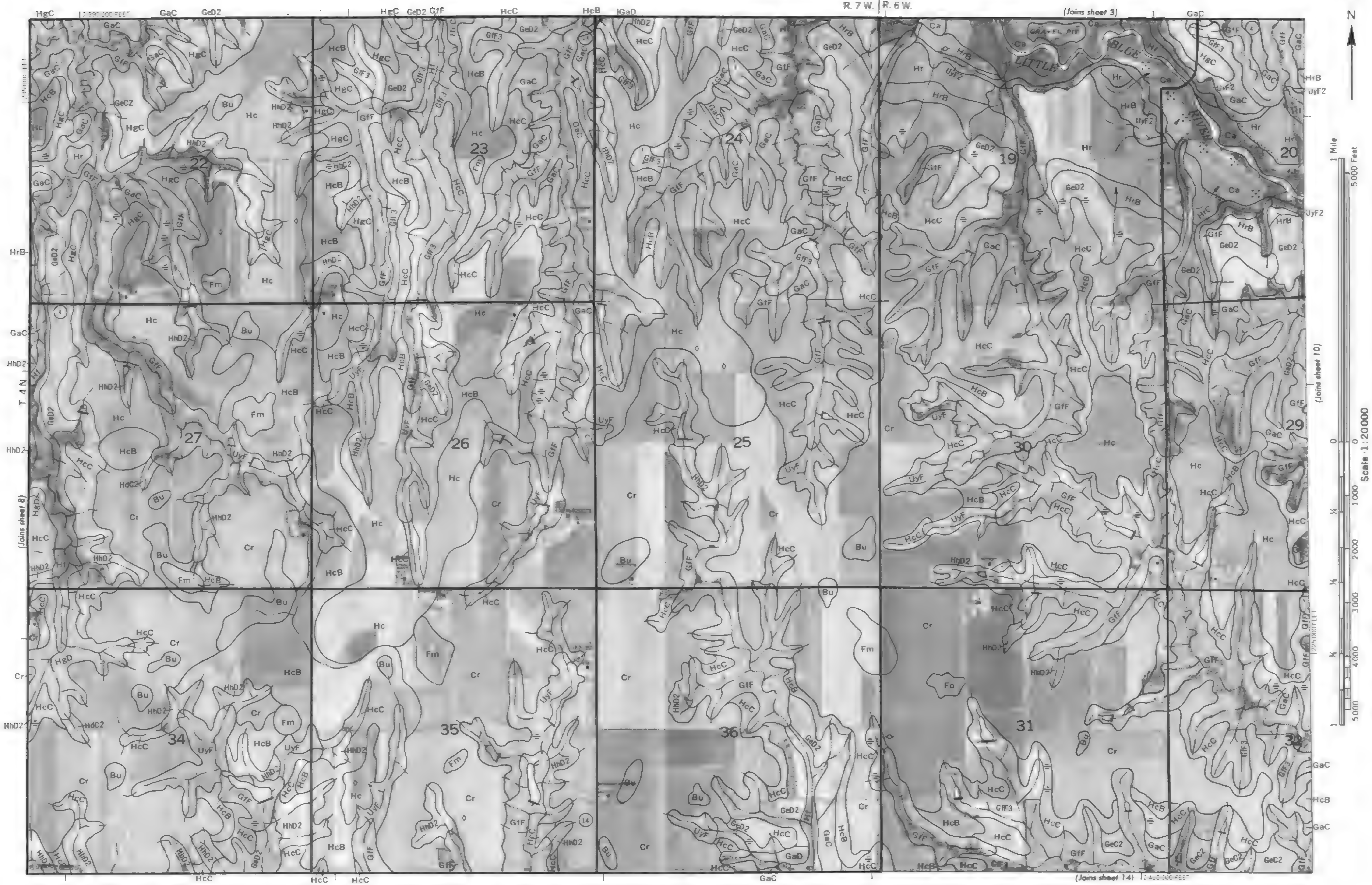
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned



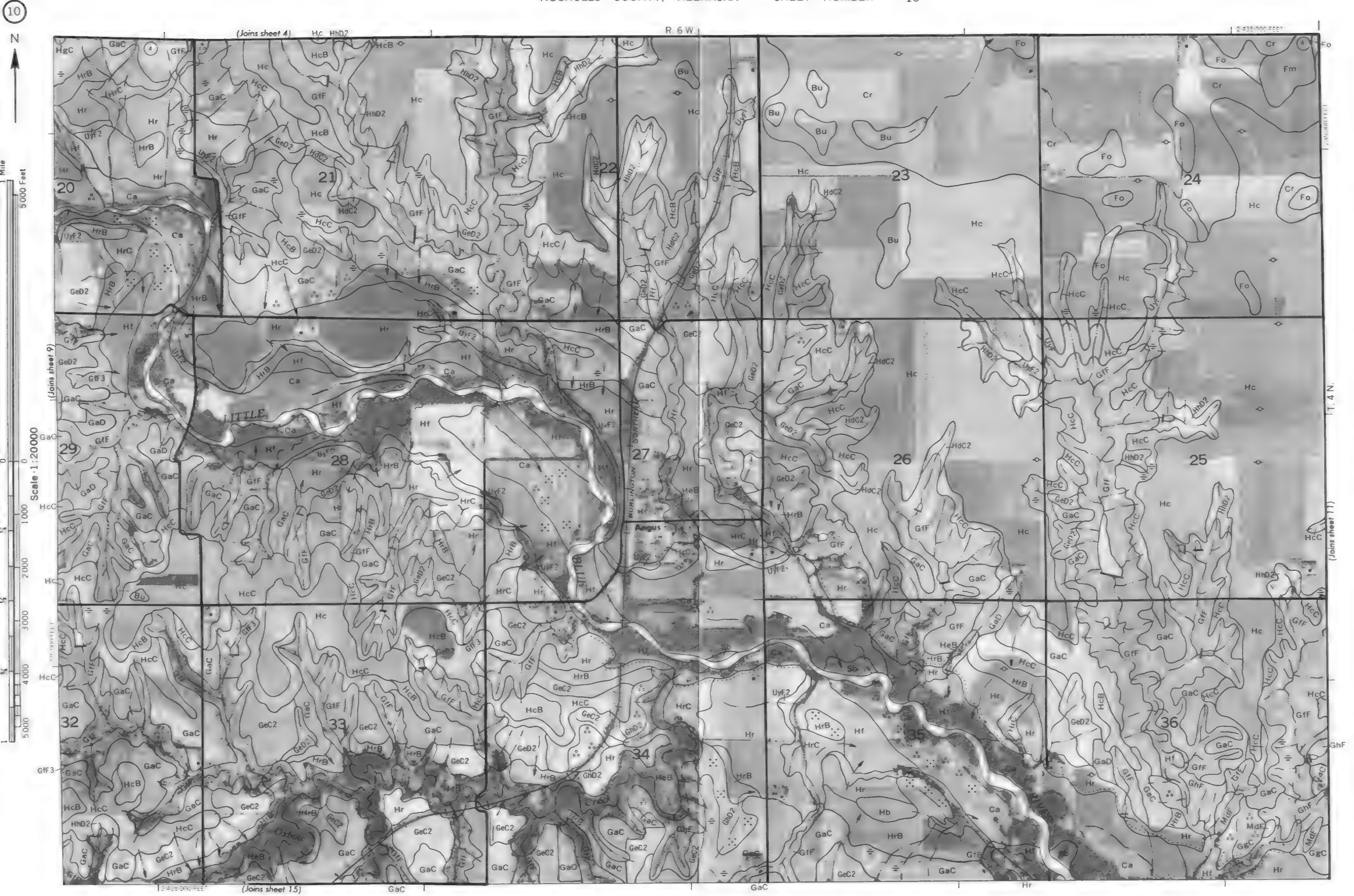
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


N
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
(Joins sheet 2)
R. 8 W.
R. 7 W.
T. 4 N.
(Joins sheet 7)
(Joins sheet 9)
(Joins sheet 13)
2 370 000 FEET
2 385 000 FEET
Walnut
Creek
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33
HcC
HcB
Hc
GaD
GaC
GfF
GfF3
GeD2
HgC
HgD
HrB
Hf
HhD2
HdC2
HhC2
Cr
Bu
Fm
UyF
UyF2

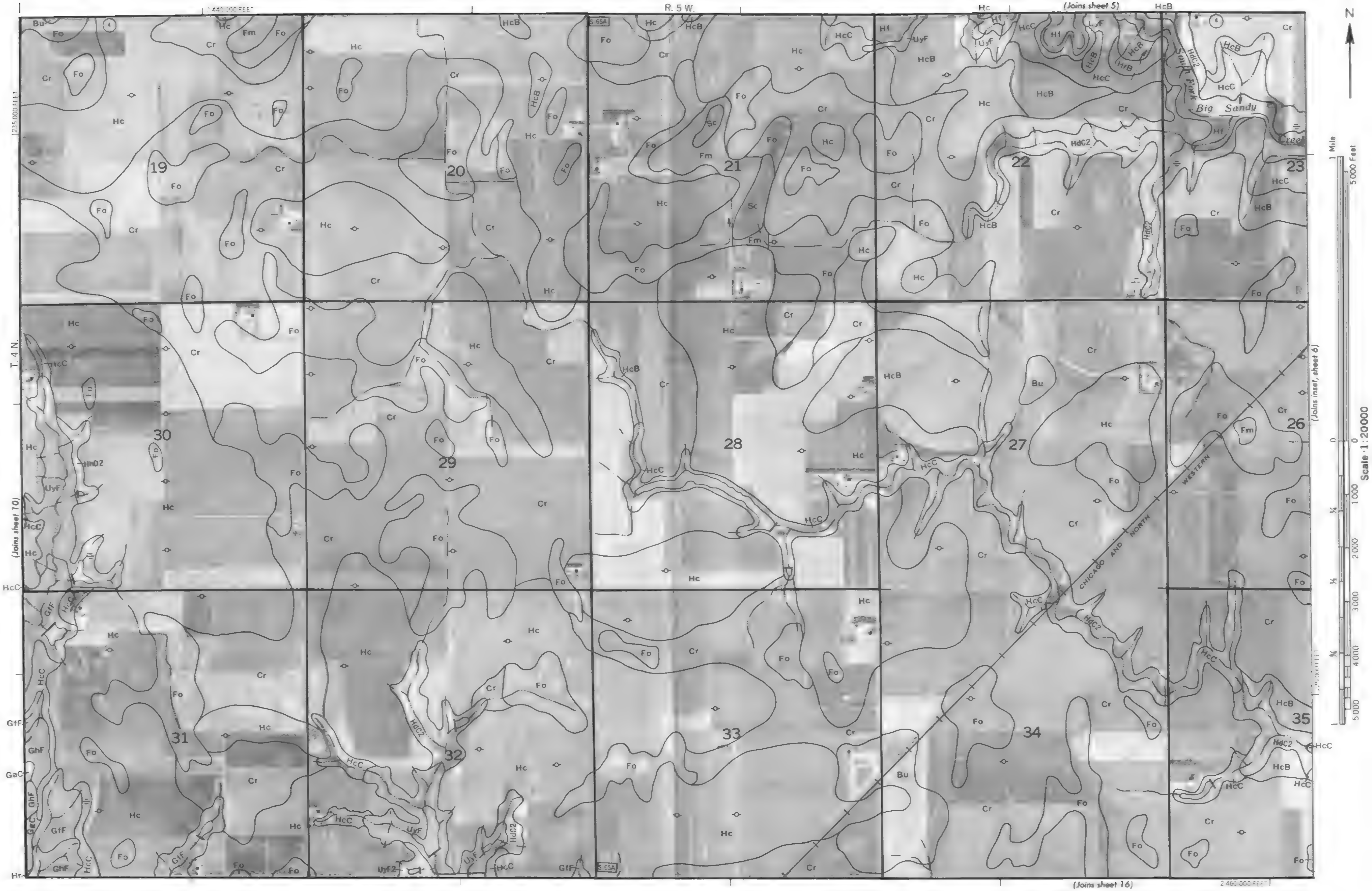
9



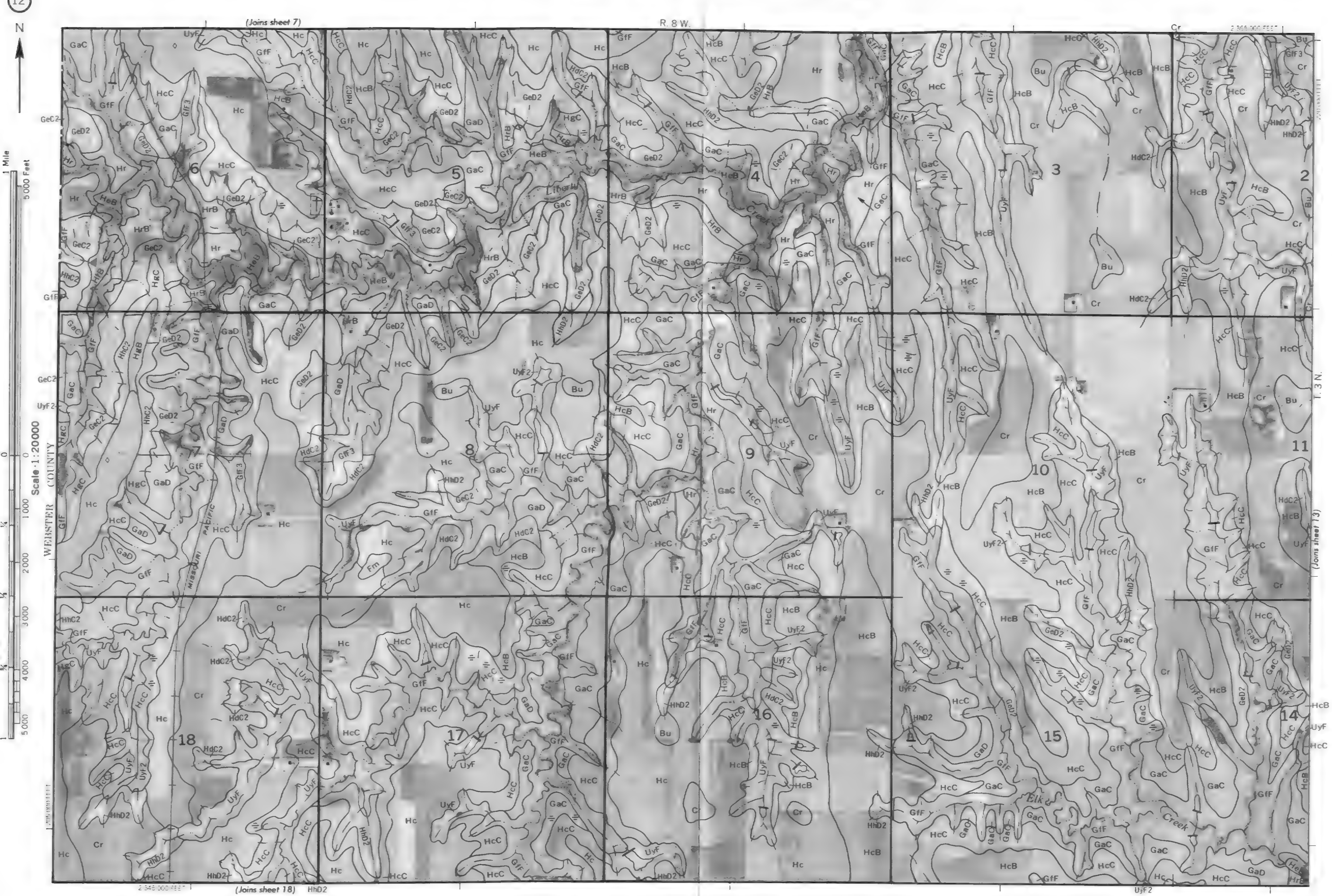
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

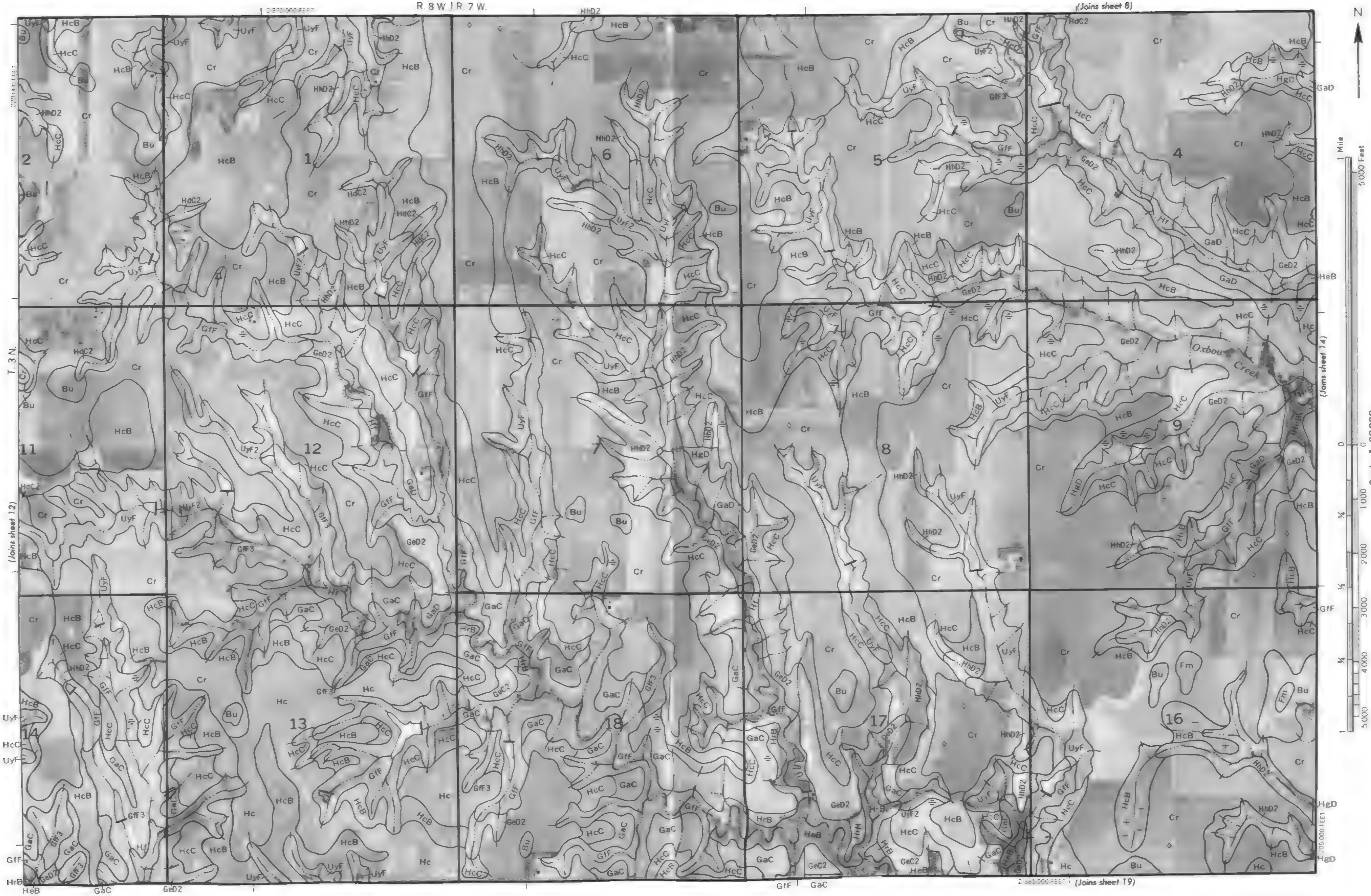

10
N
(Joins sheet 4)
R. 6 W.
T. 4 N.
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 15)
Scale 1:20000
1 Mile
5000 Feet
0 1000 2000 3000 4000 5000
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
LITTLE
BURLINGTON NORTHERN
Angus
Oxbow

11



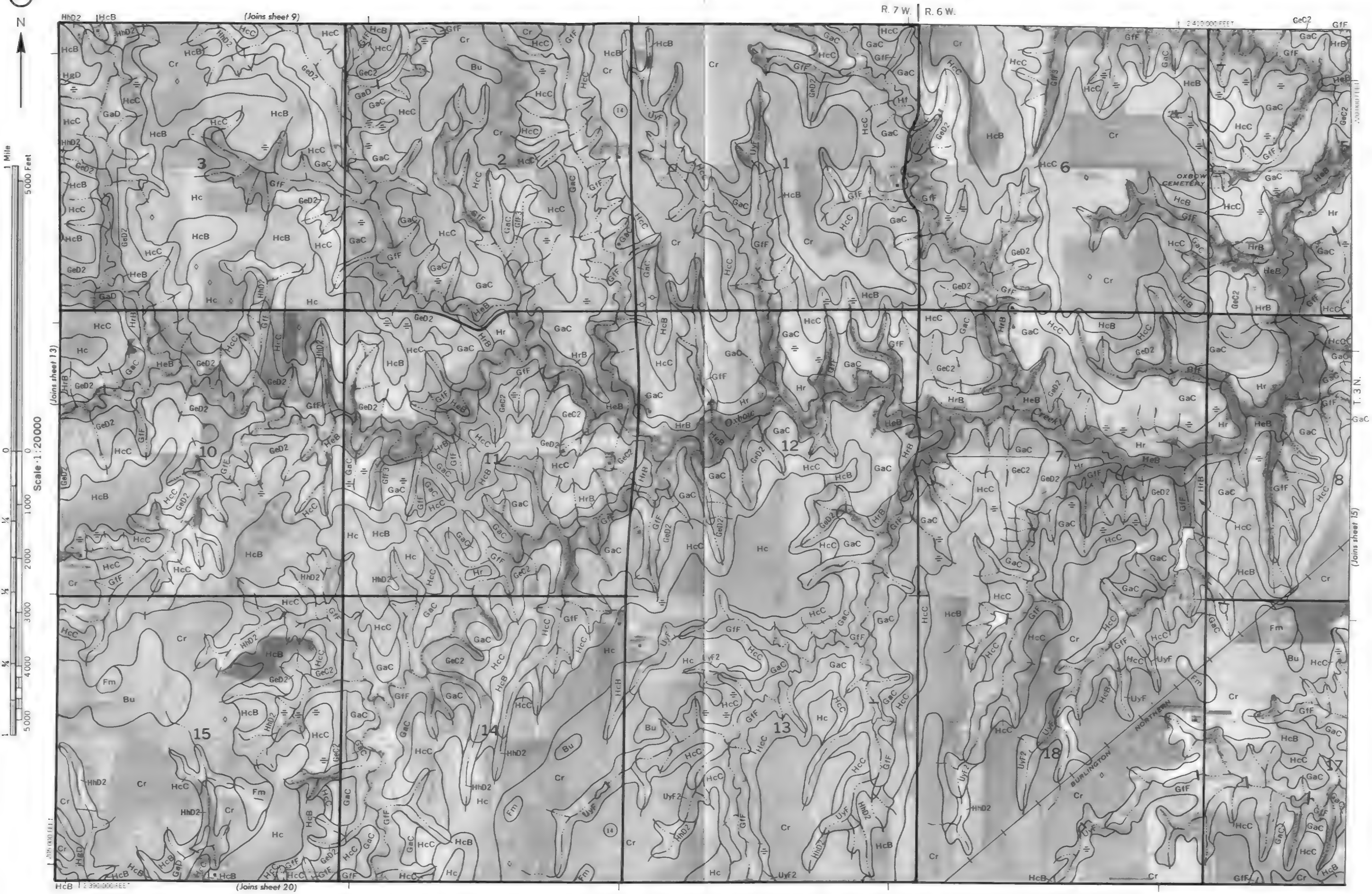
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.


12
N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 7)
R. 8 W.
T. 3 N.
WEBSTER COUNTY
MISSOURI PACIFIC
Liberty Creek
Elk Creek
(Joins sheet 13)
(Joins sheet 18)



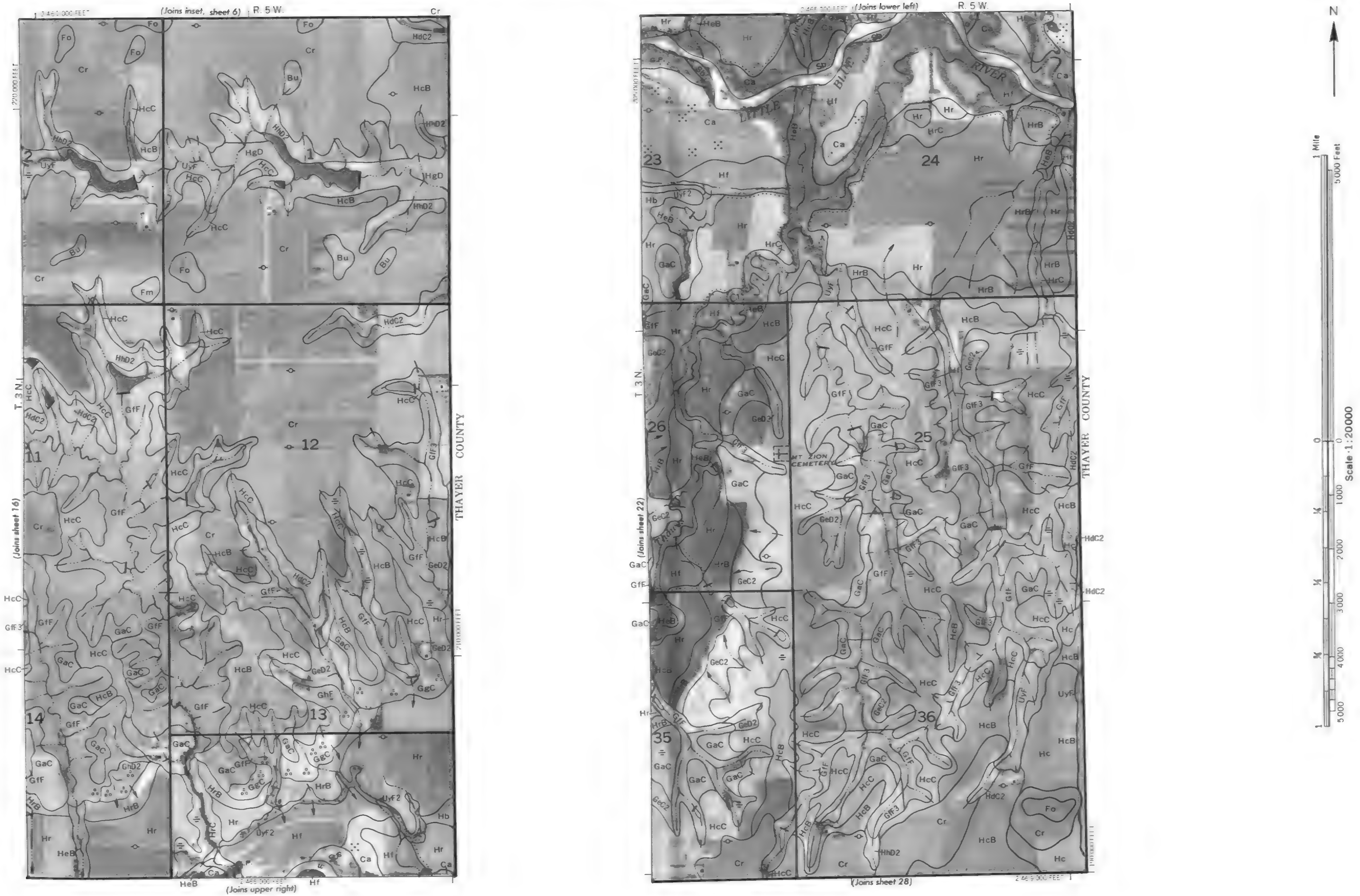
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies

NUCKOLLS COUNTY, NEBRASKA — SHEET NUMBER 14




15
N
R 6 W.
(Joins sheet 10)
T. 3 N.
(Joins sheet 14)
(Joins sheet 16)
(Joins sheet 21)
LITTLE BLUE RIVER
BURLINGTON NORTHERN
Elk
Creek
2 410 000 FEET
220 000 FEET
2 435 000 FEET
1 Mile
5000 Feet
Scale 1:20000
1
2
3
4
8
9
10
11
12
13
14
15
16
17

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

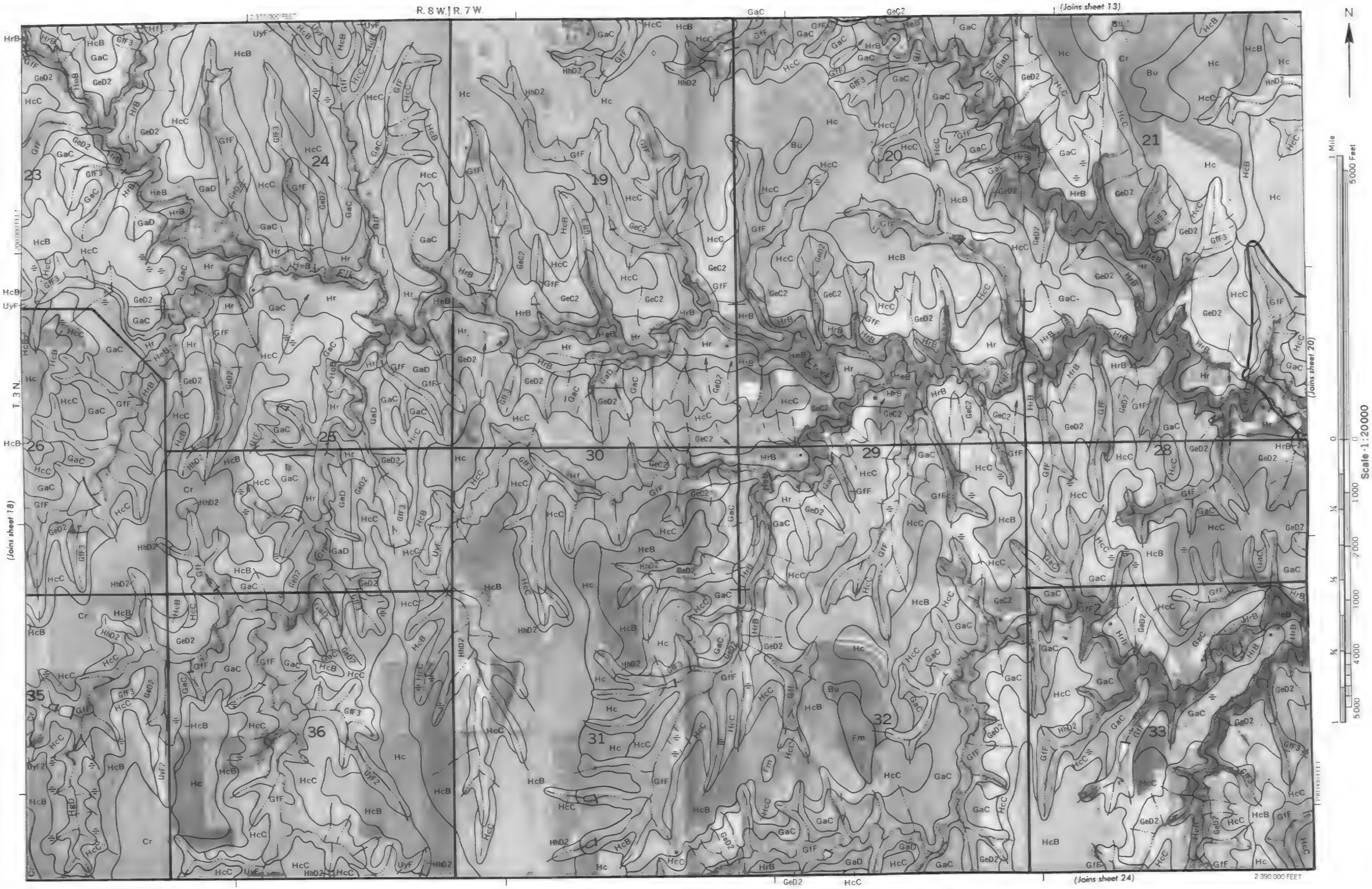


This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

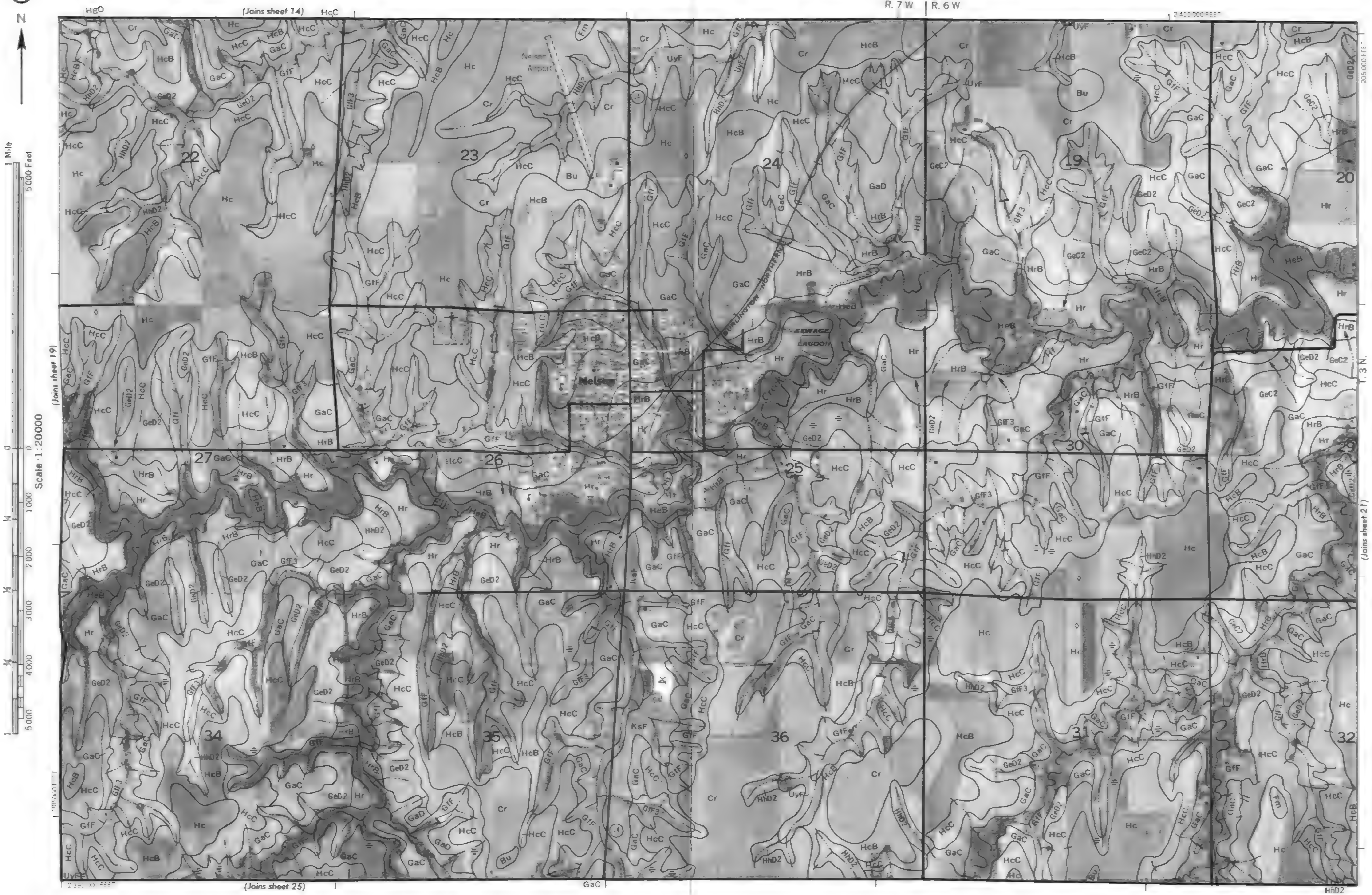
4000 AND 5000-FOOT GRID TICKS

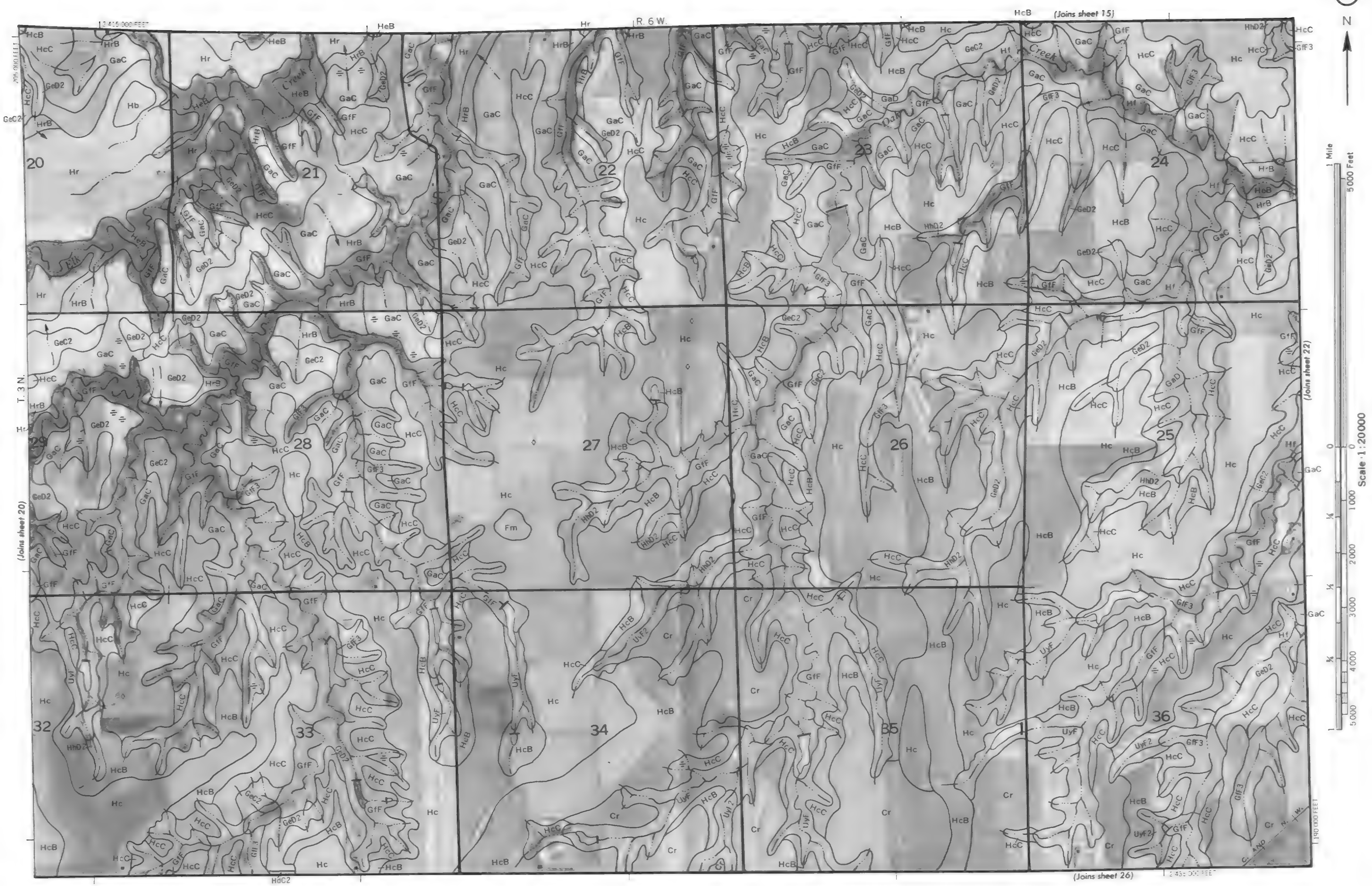
4000 AND 5000-FOOT GRID TICKS

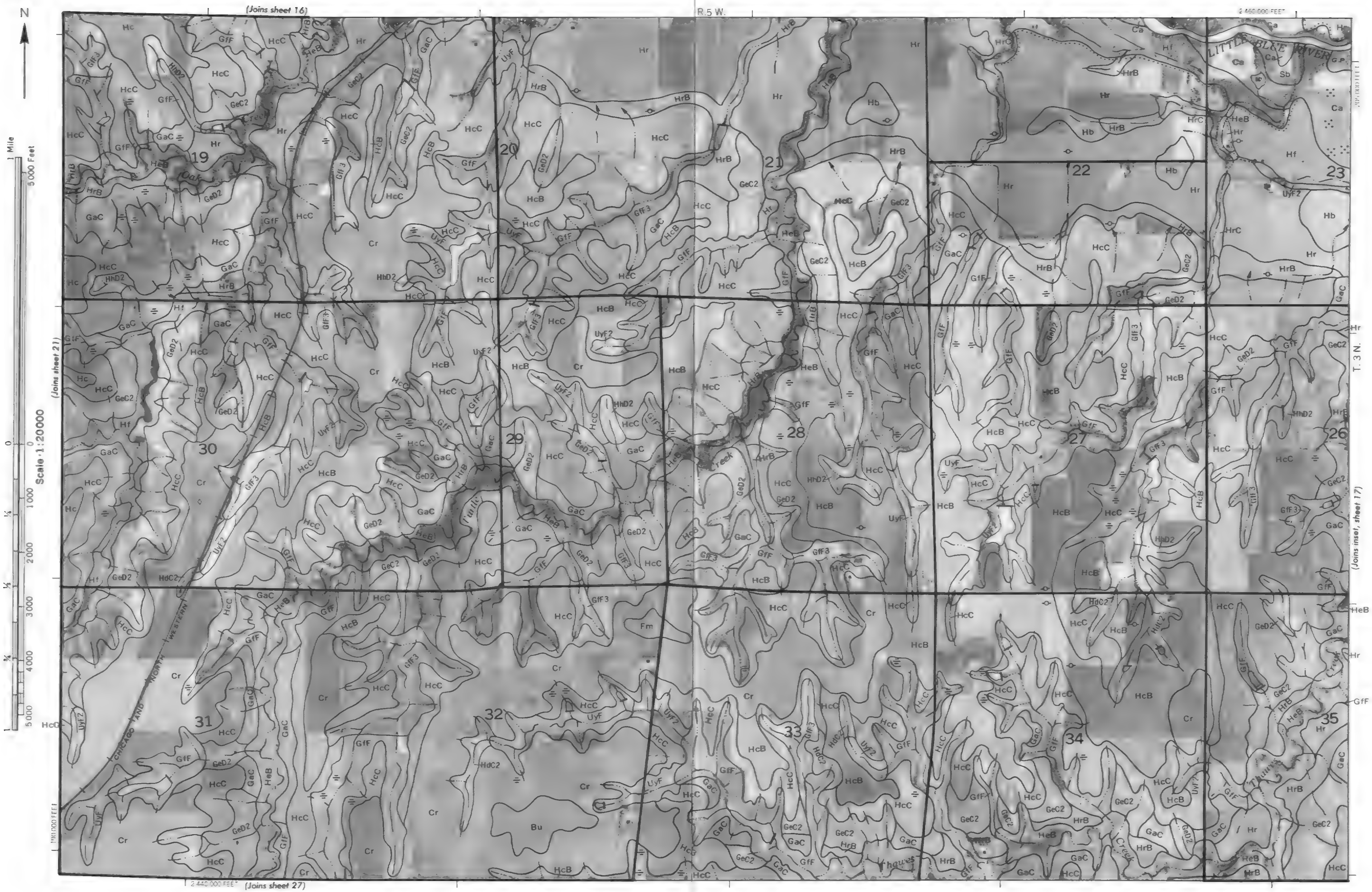
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


20
N
(Joins sheet 14)
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 25)
R. 7 W.
R. 6 W.
T. 3 N.
Scale 1:20000
1 Mile
5000 Feet
Nelson
Nelson Airport
SEWAGE LAGOON
BURLINGTON NORTHERN
Elk Creek
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32


21
N
(Joins sheet 15)
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 26)
R. 6 W.
T. 3 N.
Elk
Creek
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
1 Mile
5000 Feet
Scale 1:20000

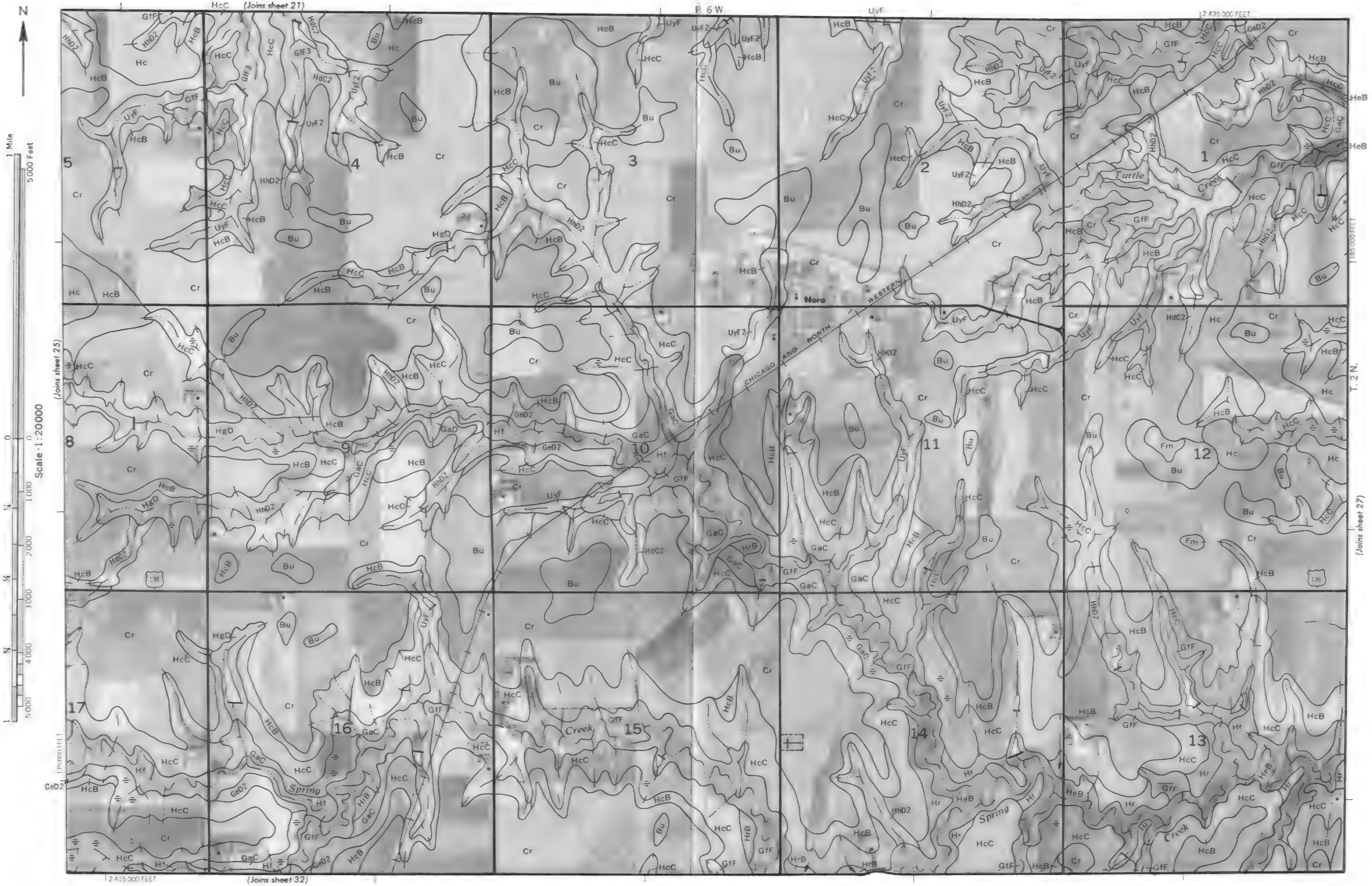

22
N
(Joins sheet 16)
(Joins sheet 21)
(Joins sheet 27)
(Joins inset, sheet 17)
R. 5 W.
T. 3 N.
2 460 000 FEET
2 440 000 FEET
1 Mile
5000 Feet
Scale 1:20000
LITTLE BLUE RIVER
CHICAGO AND NORTH WESTERN
Oak Creek
Little Creek
Thayer Creek
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

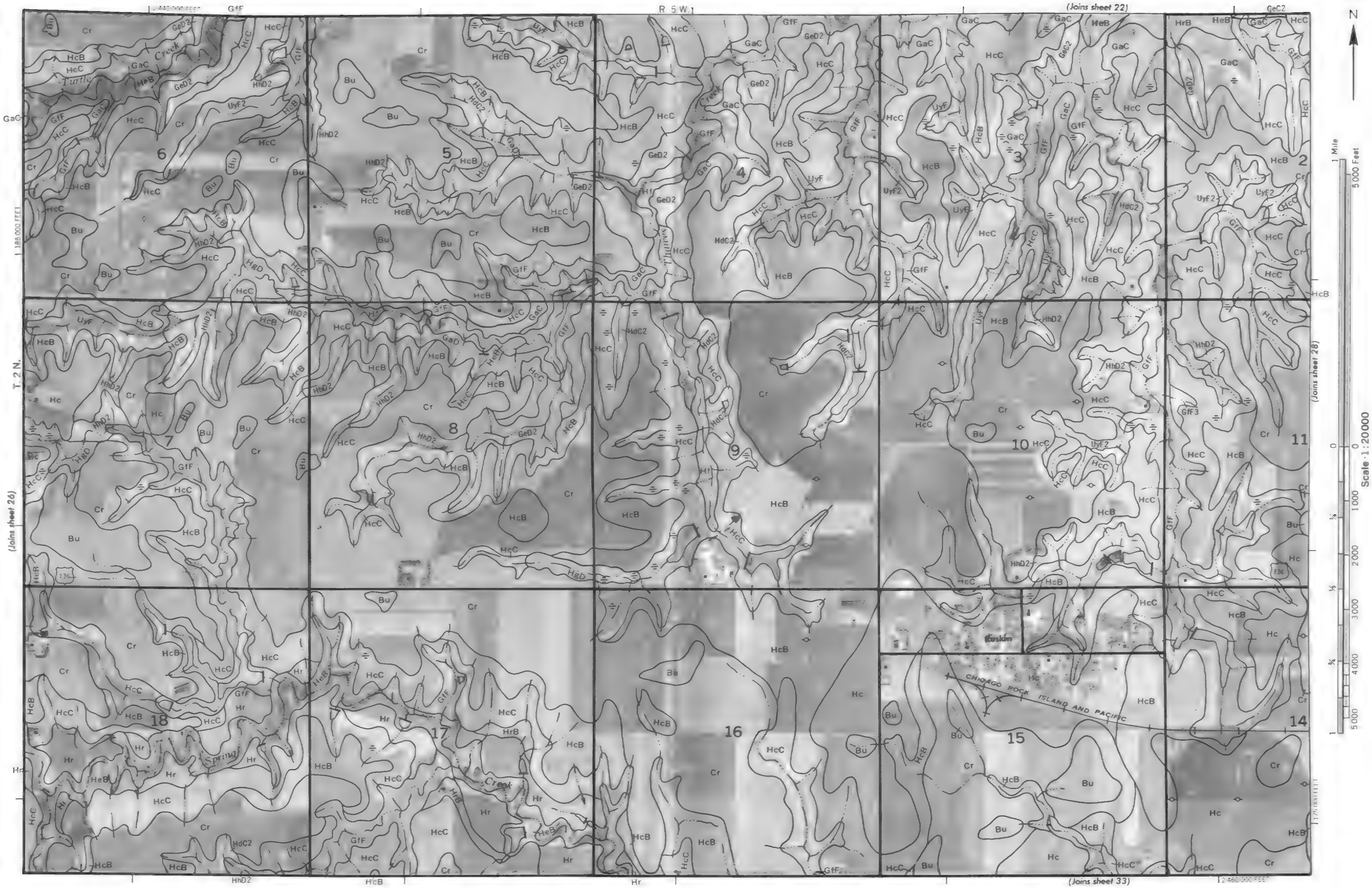
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

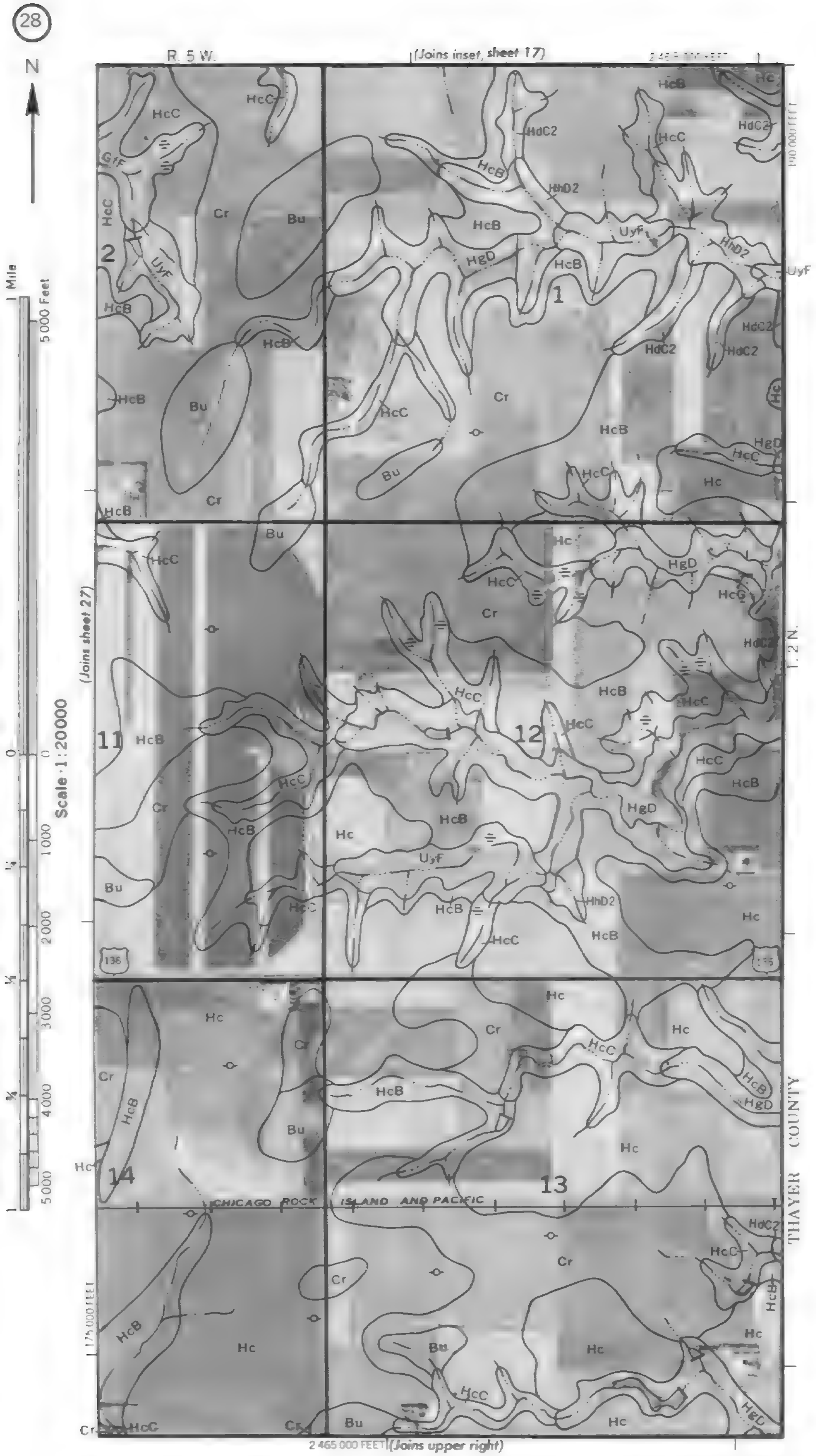

24
N
(Joins sheet 19)
R. 8 W.
R. 7 W.
2 390 000 FEET
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 30)
2 370 000 FEET
T. 2 N.
MISSOURI
PACIFIC
Sand
Creek
1
4
5
6
7
8
9
11
12
13
14
16
17
18
HcB
HcC
Hc
Cr
Bu
HhD2
HhC2
HgD
Hf
UyF
UyF2
GfF
GfF3
GaC
GeD2
NUCKOLLS COUNTY, NEBRASKA NO. 24

25

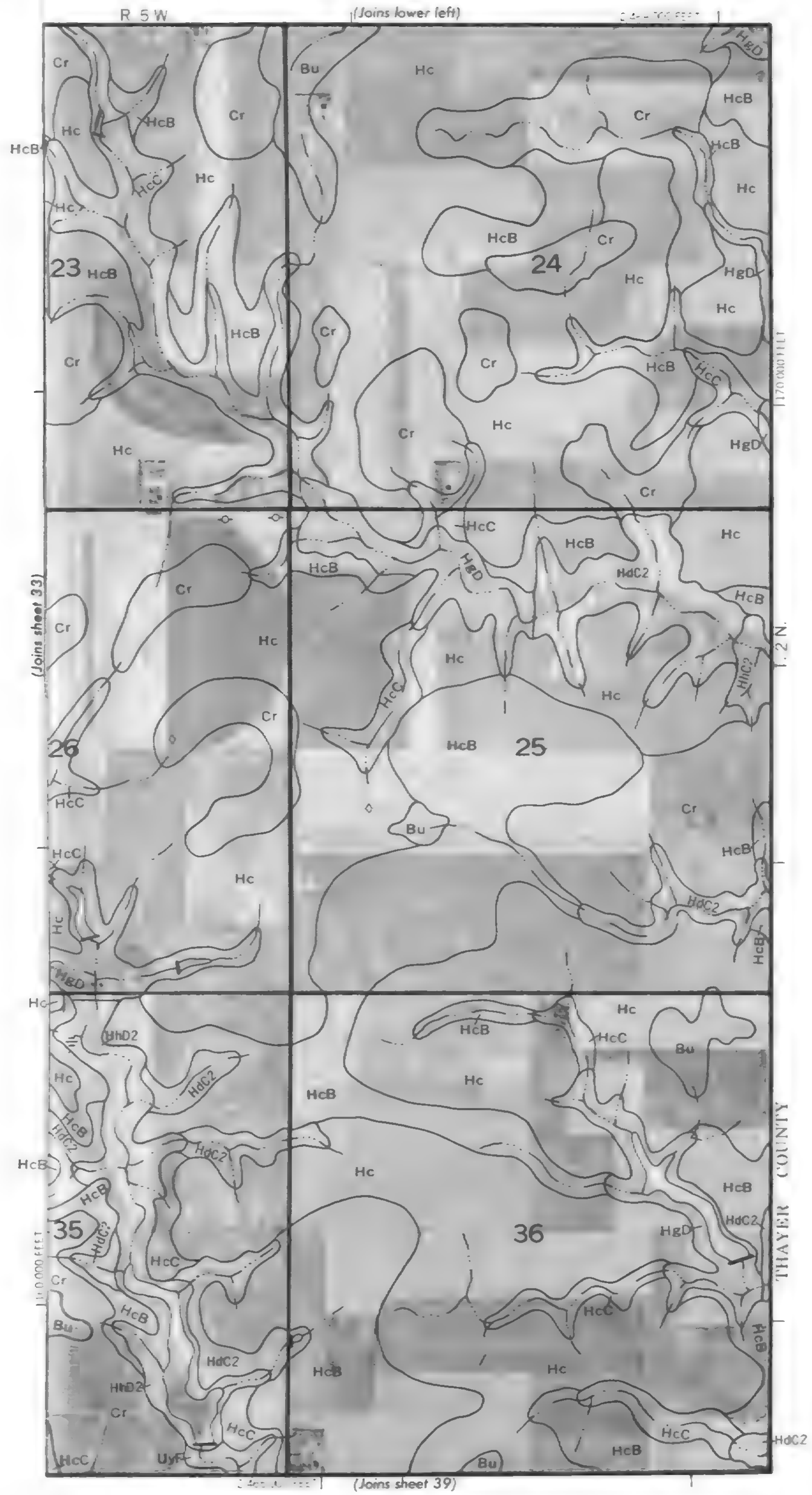
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned


26
N
(Joins sheet 21)
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 32)
R. 6 W.
T. 2 N.
2 435 000 FEET
2 415 000 FEET
185 000 FEET
1 Mile
5000 Feet
Scale 1:20000
Nora
CHICAGO AND NORTH WESTERN
Turtle Creek
Spring Creek
136
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17


27
N
(Joins sheet 22)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 33)
R. 5 W.
T. 2 N.
Turtle Creek
Spring Creek
CHICAGO ROCK ISLAND AND PACIFIC
Ruskin
136
1 Mile
5000 Feet
Scale 1:20000
6
5
4
3
2
7
8
9
10
11
18
17
16
15
14

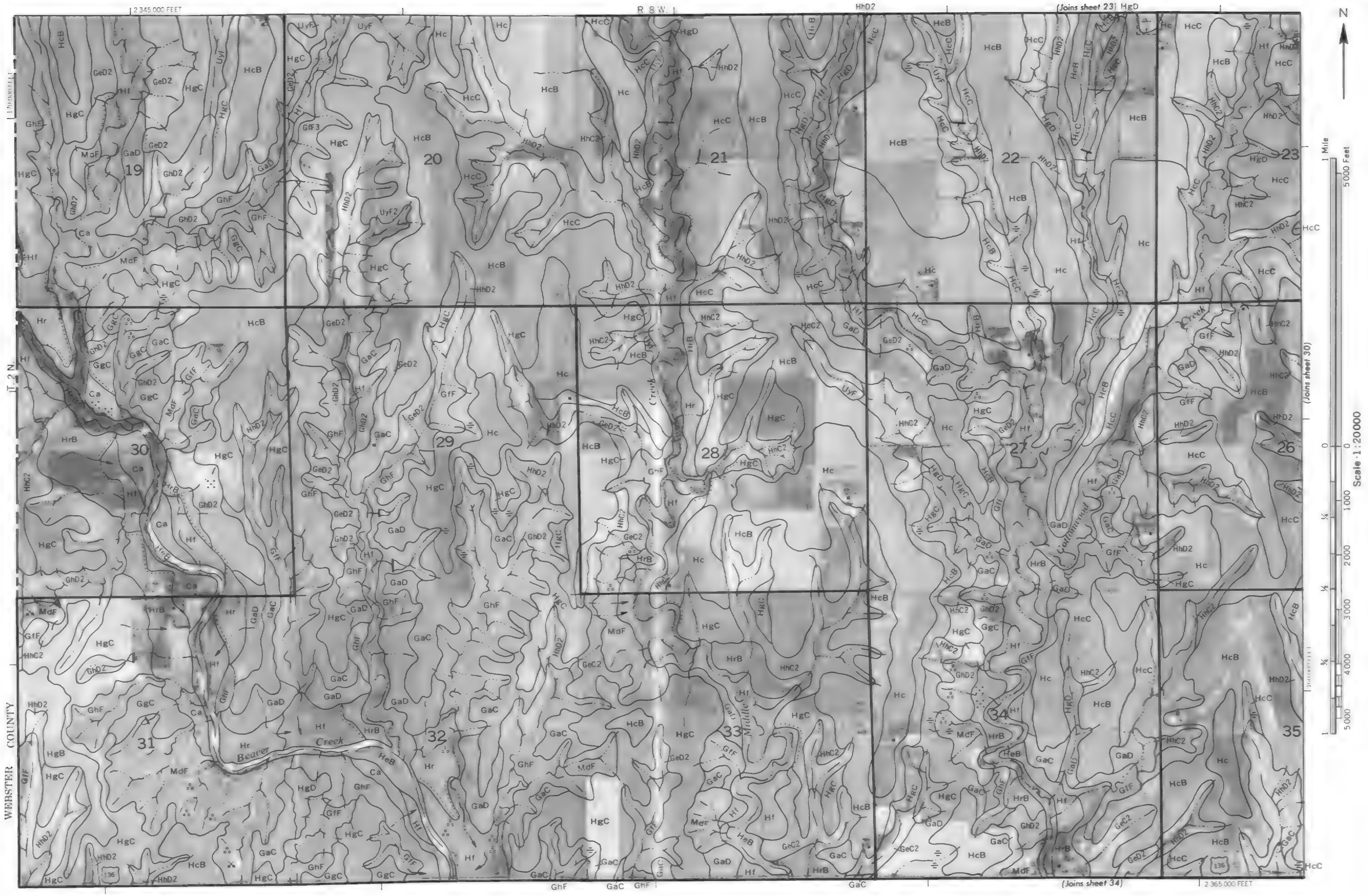


4000 AND 5000-FOOT GRID TICKS



4000 AND 5000-FOOT GRID TICKS

NUCKOLLS COUNTY, NEBRASKA NO. 28



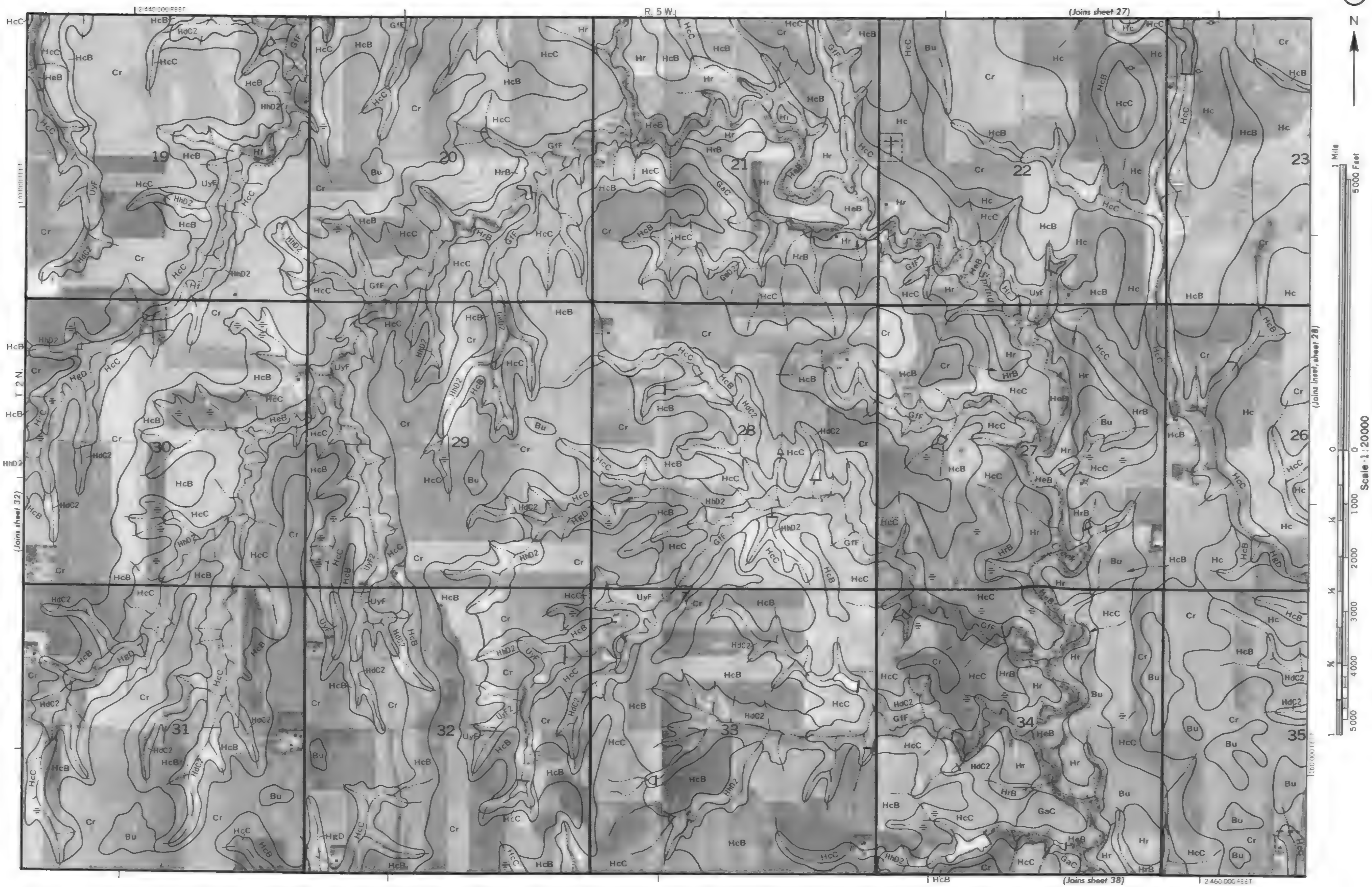
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

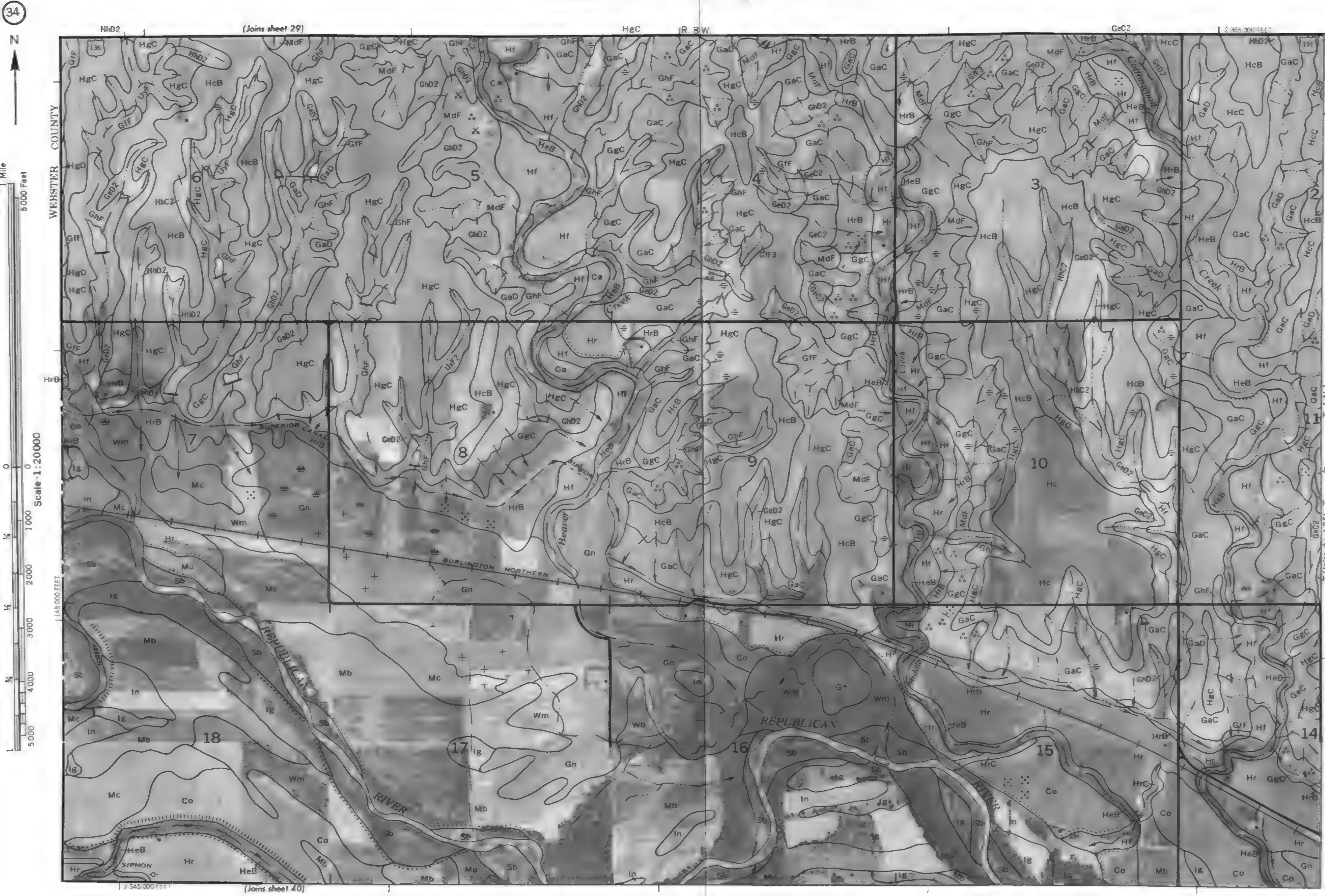
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


32
N
(Joins sheet 26)
(Joins sheet 37)
(Joins sheet 31)
(Joins sheet 33)
R. 6 W.
T. 2 N.
CHICAGO AND NORTH WESTERN
Scale 1:20000
1 Mile
5000 Feet
2 435 000 FEET
2 415 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

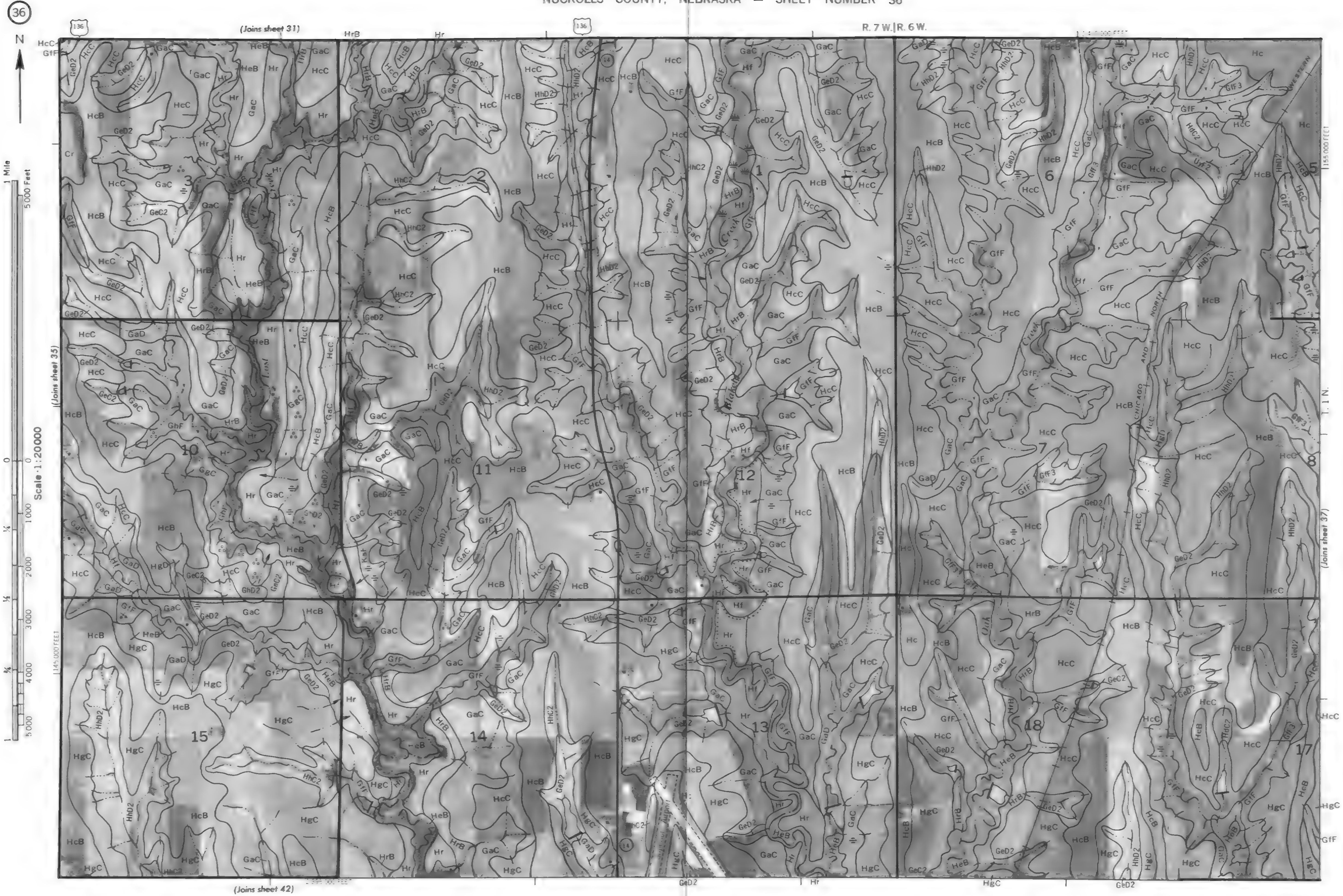




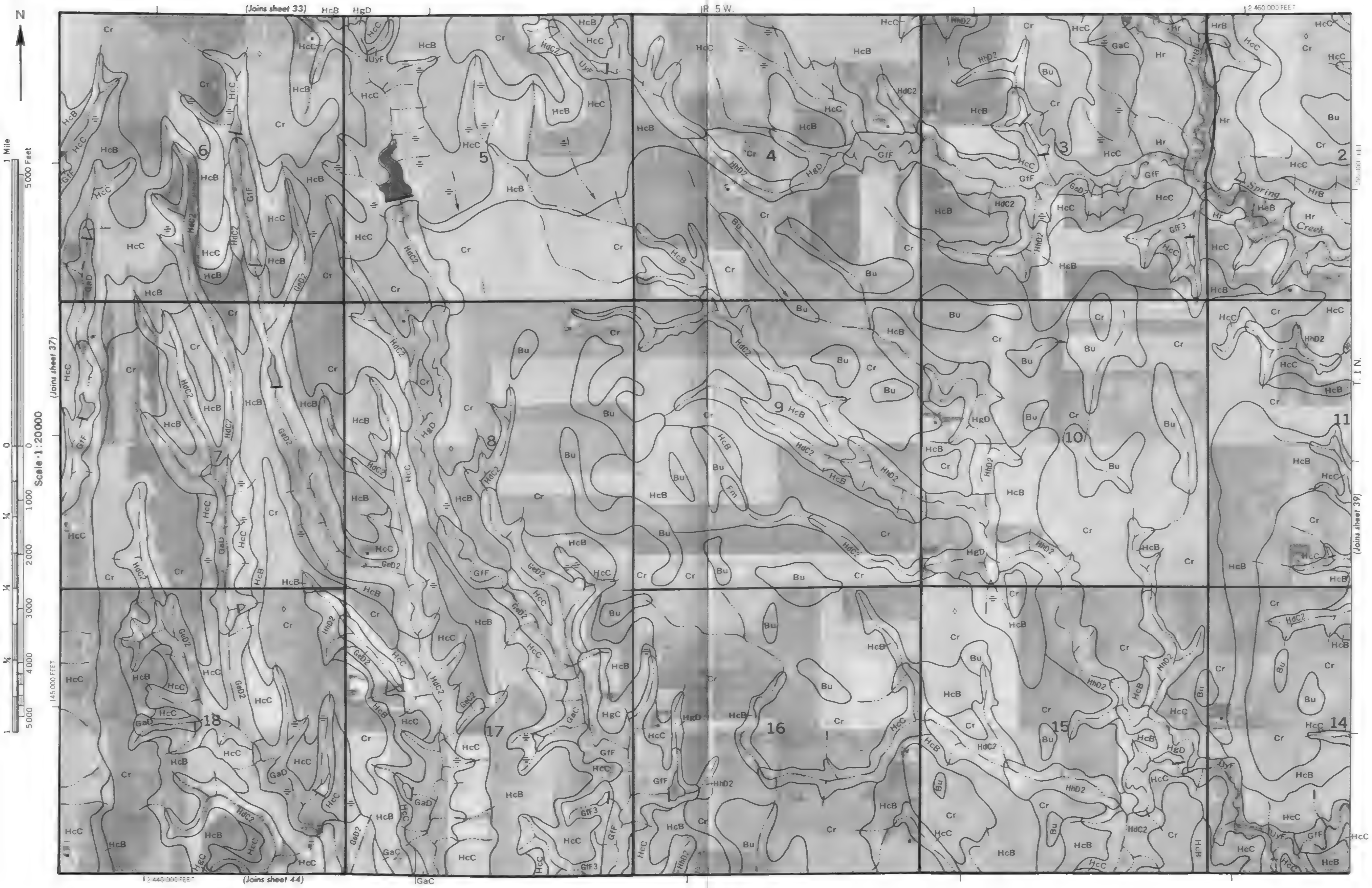
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

NUCKOLLS COUNTY, NEBRASKA NO. 34

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


36
(Joins sheet 31)
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 42)
R. 7 W. | R. 6 W.
T. 1 N.
Scale 1:20000
1 Mile
5000 Feet

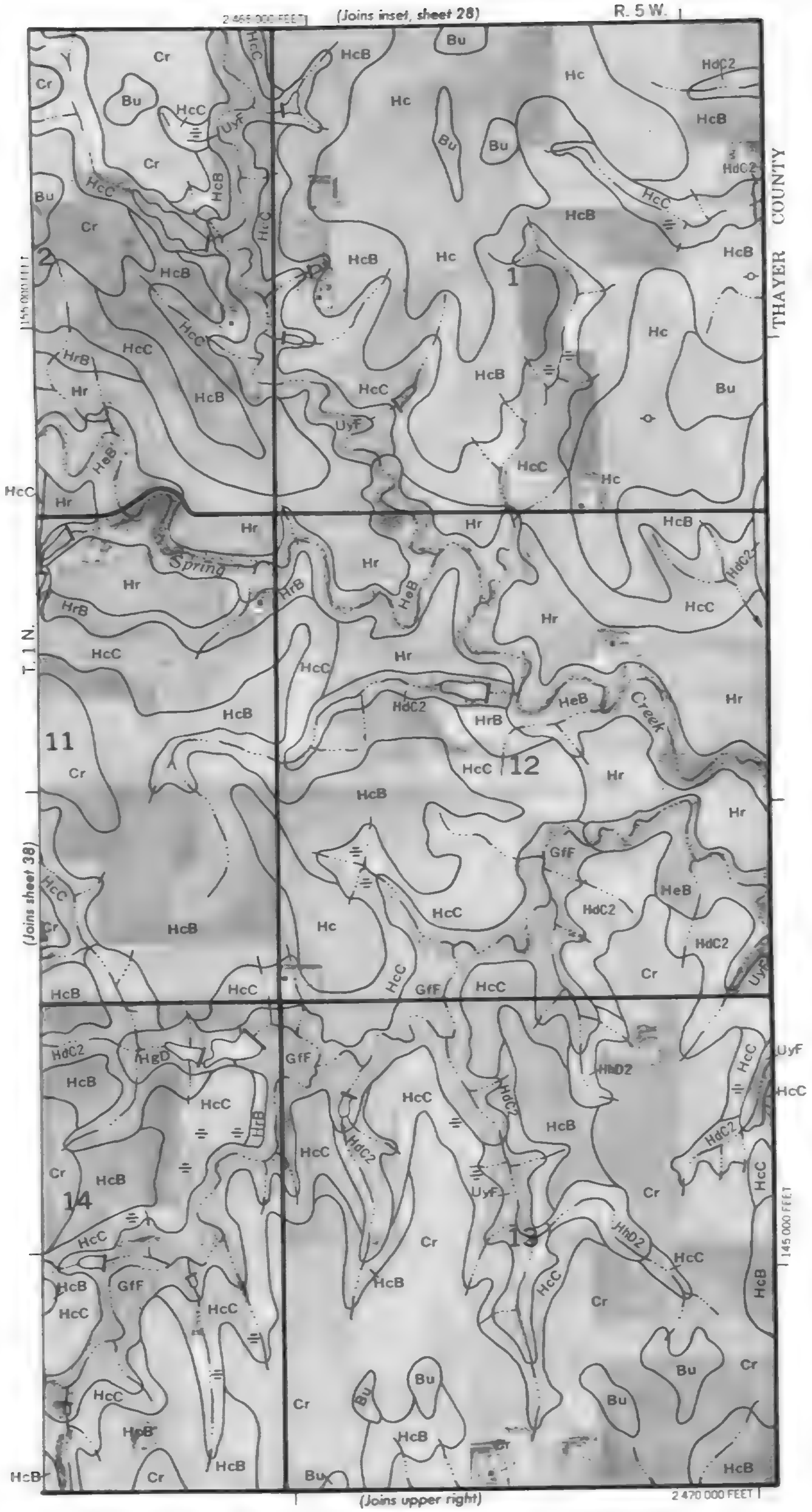
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

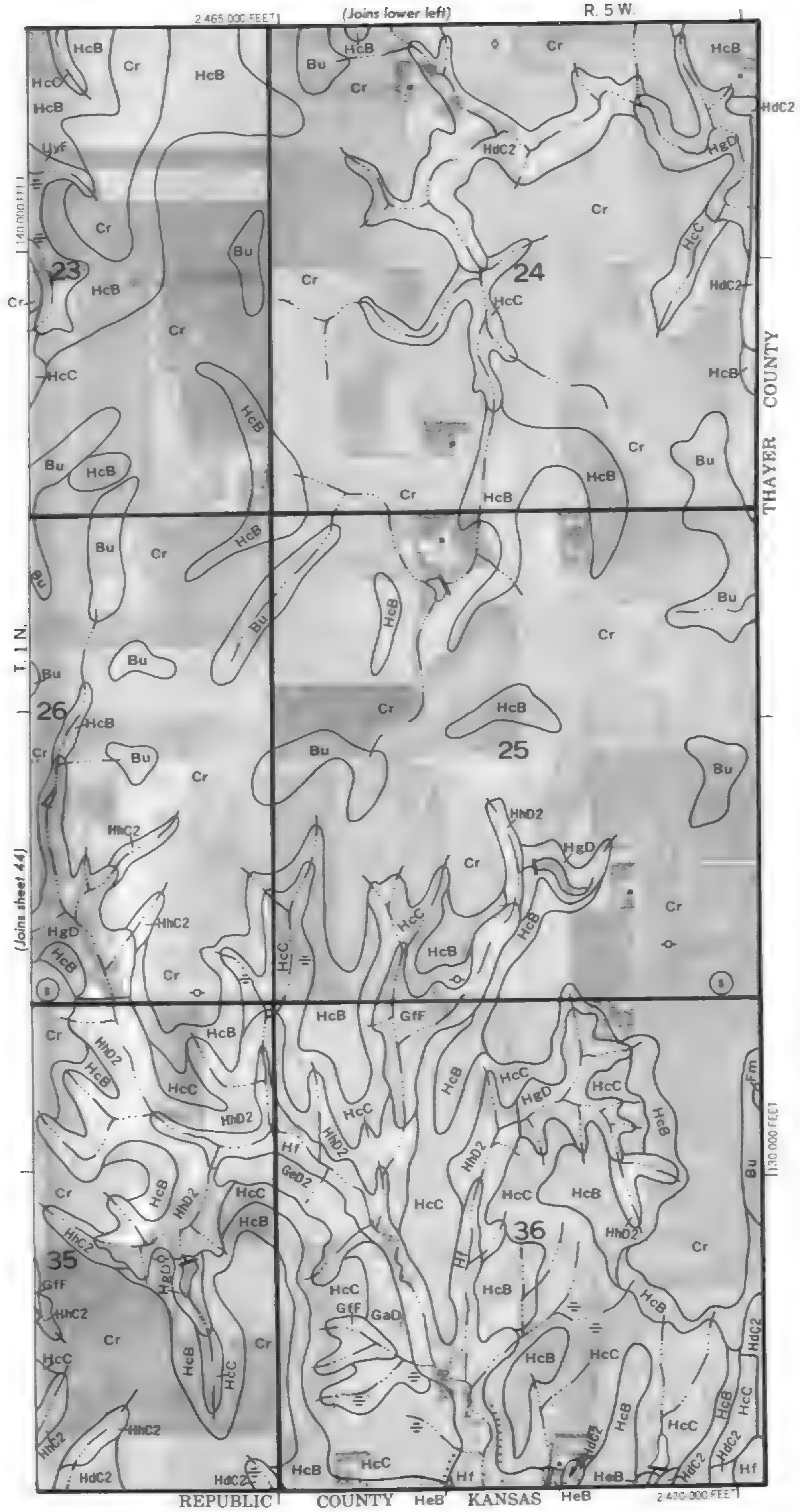


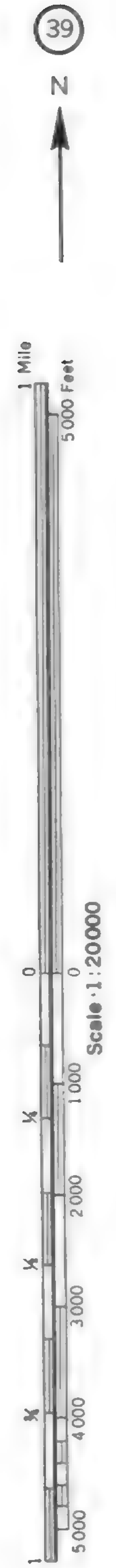
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

NUCKOLLS COUNTY, NEBRASKA NO. 38

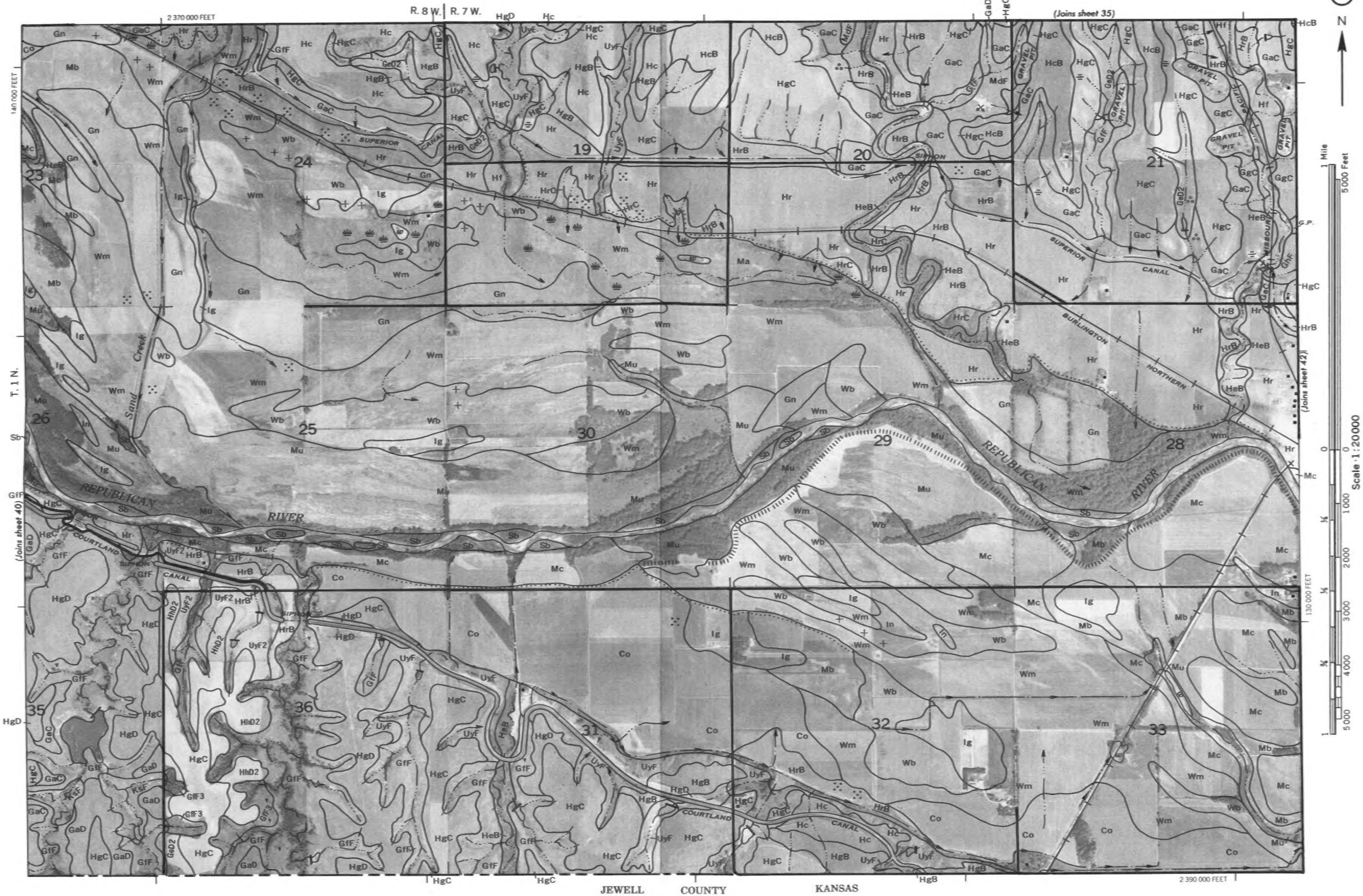
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



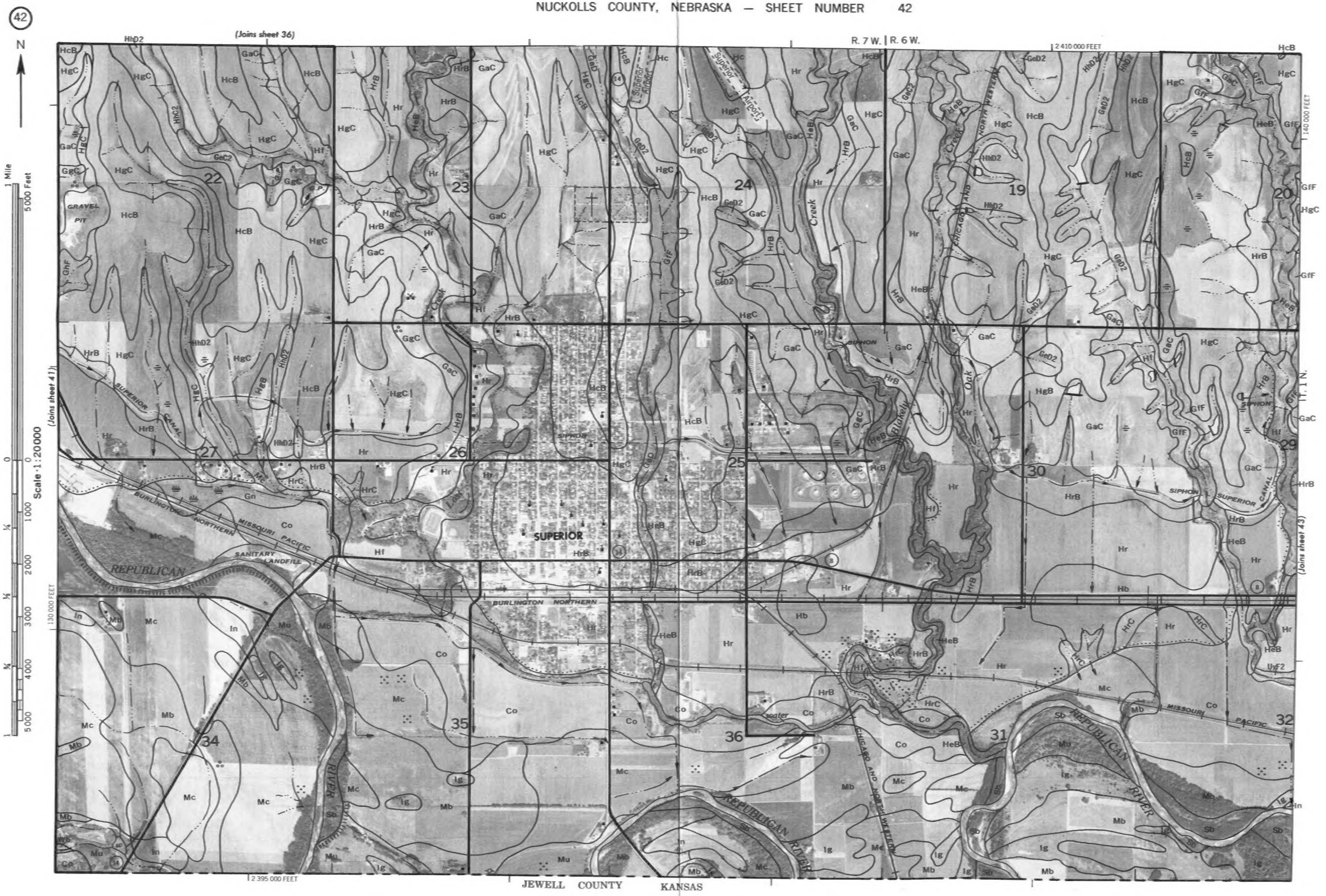





40
N
(Joins sheet 34)
R. 8 W.
(Joins sheet 41)
T. 1 N.
REPUBLICAN RIVER
COURTLAND CANAL
SIPHON
Gimlet Creek
Ayres Creek
Oak Creek
Scale 1:20 000
1 Mile
5000 Feet
WEBSTER COUNTY
JEWELL COUNTY KANSAS
2 345 000 FEET
2 365 000 FEET
140 000 FEET
120 000 FEET
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

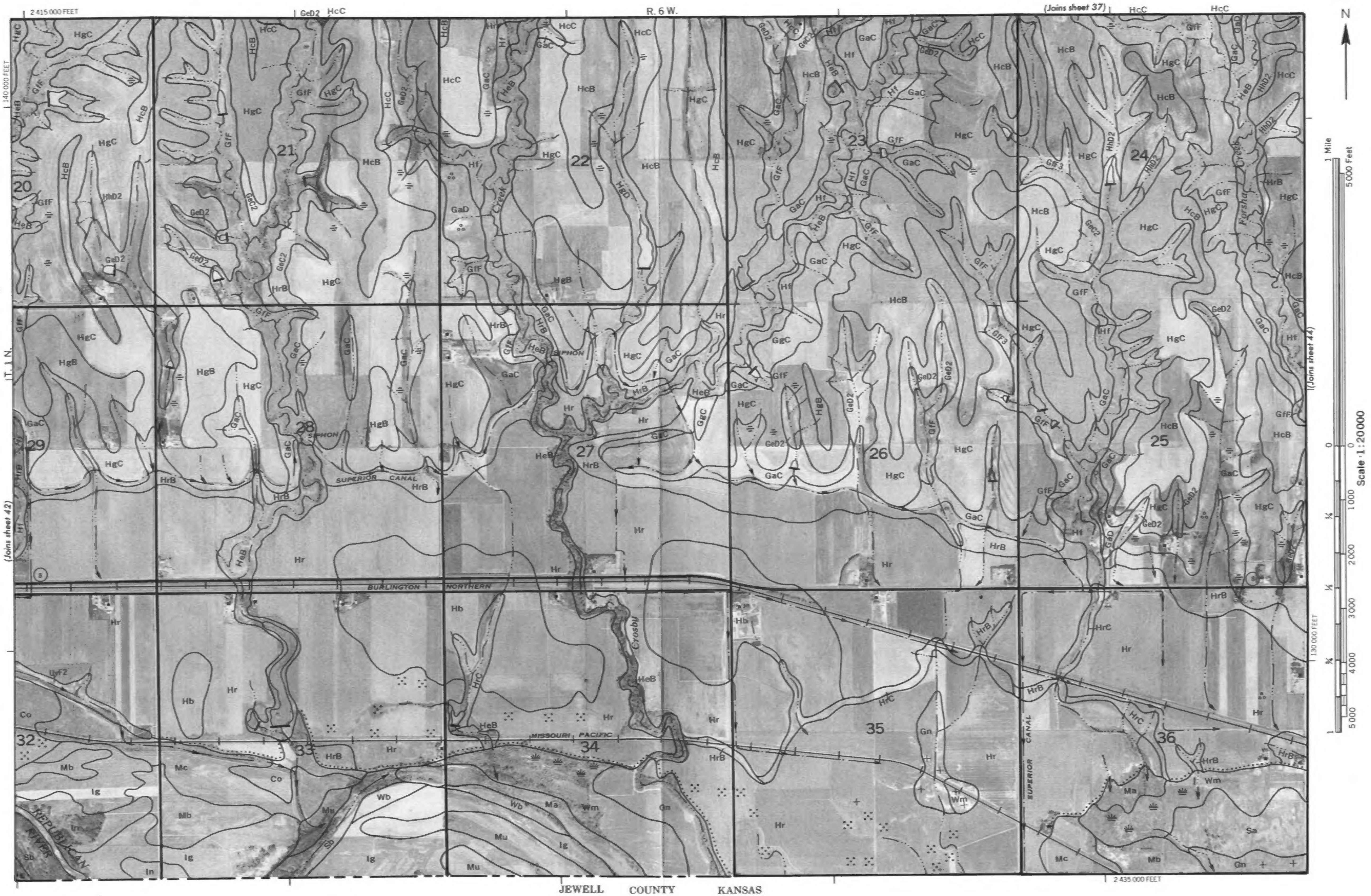


This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



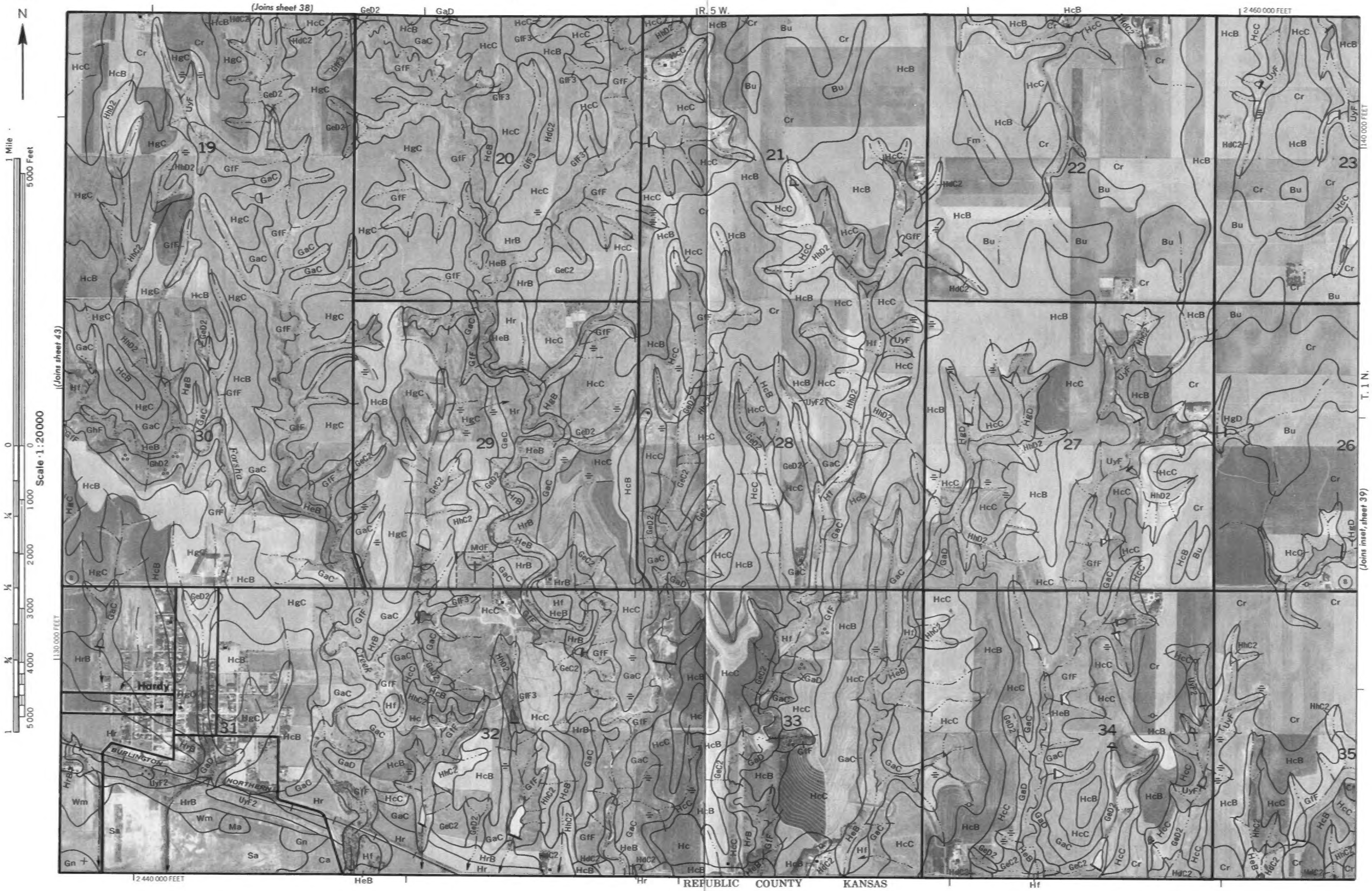
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

NUCKOLLS COUNTY, NEBRASKA NO. 42



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(44)



This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.